FIELD EVALUATION OF INSECT-RESISTANT VARIETIES ON POPULATIONS OF THE COTTON BOLLWORM, TOBACCO BUDWORM, COTTON FLEAHOPPER, BENEFICIAL INSECTS AND SPIDERS, FRUIT DAMAGE, AND YIELD OF COTTON

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TABLE OF CONTENTS

LIST OF TABLES

Table | Page

Table		Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The search for insect-resistant cotton varieties is aimed at finding an effective alternative control measure to lessen dependence on chemical controls. Research efforts continue to develop and test cotton varieties in the hope of finding varieties which will resist insect damage without decreasing yield or quality. This could reduce chemical insecticide usage, production costs, and environmental hazards. This experiment, which took place during the 1976 and 1977 growing seasons, involved field testing and evaluation of four insect-resistant cotton varieties. This study is part of a seven-state beltwide program initiated and directed by Dr. M. J. Lukefahr, Entomology Research Division, Agricultural Research Service, USDA, Brownsville, Texas.

This experiment has attempted to ascertain the relative abundances of beneficial insects and arthropods found on each cotton variety, including the lady beetles, primarily *Hippodamia* spp.; the green lacewings, *Chrysopa* spp.; the nabids or damsel bugs, *Nabis* spp.; the soft-winged flower beetles, *Collops* spp.; the hooded flower beetle, *Notoxus monodon* (Fabricius); the big-eyed bugs, *Geocoris* spp.; the minute pirate bug, *Orius insidiosus* (Say); and the spiders. The spiders were primarily members of the families Oxyopidae, Salticidae, and Thomisidae. Also counted were the Oklahoma cotton pest species: the thrips, primarily *Frankiniella* spp.; the cotton fleahopper, *Pseudato-*

moscelis seriatus (Reuter); the black fleahopper complex, Spanogonicus albofasciatus (Reuter) and Rhinacloa forticornis (Reuter); and the damage of the boll weevil, Anthonomus grandis (Boheman). However, the greatest emphasis was placed on determining the resistance potential of these cotton varieties to the Heliothis complex: the cotton bollworm, Heliothis zea (Boddie), and the tobacco budworm, Heliothis virescens (Fabricius). These two species represent the greatest danger to cotton production in Oklahoma today, and most attempts at cotton breeding for insect resistance have been aimed at their control.

CHAPTER II

REVIEW OF THE LITERATURE

Cotton insect damage is one of the chief limiting factors in efficient cotton production. Since 1929, cotton growers have lost more than $100 million annually in crop reductions from insect pests and control costs. The maximum loss of more than $900 million to cotton insects occurred in 1950 (Young, 1969). Nearly half of all insecticides used to control pests on agricultural crops in the United States are used on cotton (Eichers et al., 1970). Confronted with the drawbacks of chemical control, efforts have been made to find alternative approaches to the control of cotton insect pests. Painter (1951, 1958) and Luginbill (1969) reviewed the value and potential of insect-resistant plants. One such alternative to chemical control is the development of insect-resistant cotton varieties.

The *Heliothis* complex was not considered a major cotton pest in Oklahoma until about 1950. Since then it has rapidly become the most destructive pest in the entire Cotton Belt (Roussel, 1976). In a study done in Mississippi, the tobacco budworm was shown to consume an average of 10 squares, 1.2 blooms, and 2.1 bolls per larva (Kincade et al., 1967). Its elevation from a secondary pest status is due, in part, to the chemical devastation of its parasites and predators and to its own ability to adapt to a succession of new pesticides. Not only has the bollworm exhibited resistance to DDT, but also to carbaryl, strobane, toxaphene, endrin, and methyl parathion (Adkisson and Nemec, 1965; Brazzel, 1963, 1964; Lowry et al., 1965; Graves et al., 1964; Adkisson, 1968; Wolfenbarger and McGarr, 1970). On these bases, it is apparent that the Heliothis complex is becoming a pest of tremendous economic danger, practically unstoppable by standard control measures.

Population models have been developed for insect species with reproduction potentials similar to the Heliothis complex (Knipling, 1972). From these models it can be estimated that an 80 percent suppression of each generation is necessary to obtain a static (maintenance) population. On this basis, Lukefahr et al. (1975) define a Heliothis-resistant cotton variety as that variety which suppresses insect populations 80 percent below those on a susceptible variety.

The presence or absence of certain morphological structures of the cotton plant are responsible in part for resistance to insect pests. Among these structures are the nectaries, glandlike organs found in association with the flower, the midrib of the abaxial leaf surface, and the bracts. The nectaries secrete a sweetish fluid which serves as a food source for many pests, such as the boll weevil and the Heliothis complex. Nectariless cottons have no extrafloral nectaries, so that once the floral nectar is gone insects must seek food elsewhere. Meyer and Meyer (1961) first described the inheritance of the nectariless trait in upland cotton when they succeeded in transferring the nectariless character from Gossypium tomentosum Nutt. to Gossypium hirsutum L. Since then, much interest has been shown in the development of nectariless cottons. Lukefahr and Martin (1964) and Lukefahr et al. (1965) reported bollworm oviposition was reduced from 39 percent to 64 percent on nectariless cotton varieties. A similar reduction of egg numbers on nectariless cottons in cage tests at Brownsville, Texas, was demonstrated by Davis et al (1973).

Since nectariless cottons decrease amounts of food available to adult bollworms, fecundity and longevity of the adults have been shown to be reduced. A 50 percent reduction in fecundity was attained in a replicated field-cage experiment where the movement of the adults could be controlled (Lukefahr and Rhyne, 1960). A 40 percent reduction in egg deposition and some reduction in longevity was achieved in nectariless cottons when opposed to a standard variety (Lukefahr et al, 1965). This factor is impossible to measure in small plots where the mobility of the moths is unrestricted, but it is believed that if the nectariless character were widely adapted into commercial varieties, its impact would be substantial.

Another morphological difference in cotton varieties which aids in resistance to bollworm attack is the glabrous condition or absence of foliar hairs or trichomes. Commercial varieties of G. hirsutum often contain 500-2000 trichomes per square inch on the terminals or growing points. Ultrasmooth glabrous lines may have no more than 50 trichomes per square inch. A glabrous plant seems to be less preferred for oviposition than a pubescent or hirsute plant (Lukefahr et al., 1968, 1970). Glabrous leaves appear to provide an unsatisfactory surface for oviposition which results in fewer eggs deposited, and, ultimately, fewer larvae and fewer damaged fruit (Lukefahr and Rhyne, 1960; Lukefahr et al., 1971). Lukefahr (1965) reported that oviposition was effectively reduced by 60 percent on glabrous plants. In developing a technique for determining oviposition preference of the bollworm and tobacco budworm on varieties and experimental stocks of cotton, Stadelbacher and Scales (1973) found hirsute varieties to be preferred oviposition sites.

The presence of internal glands in cotton varieties is another major factor influencing resistance to pest species. These glands are present in the seed coat and vegetative portions of the plant, and contain several pigments, the major one being gossypol (8,8'-dicarboxyaldehyde-1,1',6,6',7,7'-hexahydroxy-5,5'-diisopropyl-3,3'-dimethyl-2,2'-binapthalene). The toxicity of this phenolic yellow pigment when fed to chickens, mice, rats, rabbits, and other nonruminant animals has been well documented (Bailey, 1948; Eagle et al., 1948). Not only is gossypol toxic to nonruminant mammals, but it is also very toxic to many insects, including the Heliothis complex. Moreover, the removal of these glands seems to make cotton more susceptible to insect attack (Bottger et al., 1964; Maxwell et al., 1965; Murray et al., 1965; Lukefahr et al., 1966).

However, glandless cottonseed can be utilized as a source of vegetable protein for human consumption, rather than just as a source of oil or as feed for ruminants. The development of glandless cotton strains has received much attention since the early 1960's when it was demonstrated that the glands could be removed by selective breeding (McMichael, 1960; Lee, 1962; Miravalle and Hyer, 1962). It has been speculated that the increased production costs and losses in yield that accompany insect damage could offset the advantages of glandless cotton. Lukefahr et al. (1966) showed that Heliothis larval growth was twice as great on glandless than on glanded cotton strains. The glandless plants were highly attractive to several insects which are not pests of glanded commercial varieties, an indication that commercial use of glandless varieties might introduce new insect control problems.

Thus, some recent research has been directed toward the objective of developing glandless-seeded cottons with high gossypol levels in the vegetative plant parts. Plant breeders would like to be able to manipulate levels of seed and floral gossypol separately to produce combinations of value both to seed processors (low gossypol level in cottonseed) and to those interested in protecting the plant against insect attack (high gossypol in the floral parts). Lukefahr and Fryxell (1966) studied the gossypol levels of plants belonging to genera related to cotton. Their findings revealed some genera had seeds totally free of gossypol, while other plant parts contained high levels of gossypol. They recommended exploring the possibility of transferring this trait to cotton.

Because of the value of glanded cotton varieties in cotton pest management, much work has been directed toward the development and testing of high-gossypol cotton varieties. This concept is not new. Quaintance and Brues (1905) and Cook (1906) discussed the possibility of using the contents of the pigment glands to breed lines that were resistant to cotton insects. Most commercial cotton varieties have a gossypol content of about 0.5 percent to 0.8 percent. A minimum gossypol content of 1.2 percent is needed to significantly inhibit growth and development of bollworm larvae reared in the laboratory. A high-gossypol line was developed from crosses of commercial cottons with several wild strains by Lukefahr and Houghtaling (1969). In replicated cage tests, their high-gossypol line provided a 60 percent reduction in larval populations after the second generation. Experiments designed to determine the optimum gossypol percentage in different sized cotton buds showed that the size of the bud had no effect on the percentage of gossypol in G. arboreum L., and only small differences were measured in G. hirsutum and G. barbadense (Shaver and Parrott, 1970). Wilson and Lee (1971) studied the relationship of glandulosity and Heliothis damage to cotton seedlings. Their findings indicate that the most glandular seedlings are attacked the least.

Various researchers have incorporated gossypol into artificial diets and reported their results. Only 30 percent of bollworm larvae survived to the pupal stage when fed an artificial diet containing 0.2 percent gossypol (Lukefahr and Martin, 1966). Shaver and Parrott (1970) demonstrated that the growth of older larvae of the bollworm and tobacco budworm was less affected than that of younger larvae by diets containing gossypol. Gossypol incorporated into an artificial diet was shown to be toxic to both bollworm and tobacco budworm (Shaver and Lukefahr, 1969). Oliver et al. (1971) showed that bollworm larvae fed on lyophilized squares of glanded cotton were smaller than those fed on the lyophilized squares of glandless cotton. The smaller size was shown to be a result of decreased food consumption plus a reduction in efficiency of food conversion. Although decreasing the potential of cottonseed for human consumption, the widening usage of high gossypol cottons is becoming an increasingly important tool in host plant resistance.

Another resistance mechanism is earliness. This is the ability of cotton to fruit prolifically and mature rapidly. It has been used to escape the late season buildup of boll weevil, bollworm, and budworm populations. Short season varieties also allow earlier harvesting when weather conditions are usually less adverse.

Most promising in the development of Heliothis-resistant cotton varieties is the integration of various resistance features into a single variety. Lukefahr et al. (1965) found that oviposition by adult bollworms was reduced by 80 percent on cotton plants possessing both nectariless and glabrous characters. Further tests of four lines with a combination of high-gossypol and glabrous characteristics suppressed populations 60-88 percent (Lukefahr et al., 1975). It is their contention that, since each of the three characteristics has a different mode of action, cotton with all three resistance mechanisms should be more permanently resistant than cotton with only a single type of resistance.

Of additional importance to cotton producers is the role of host plant resistance against the cotton fleahopper and black fleahopper complex. The cotton fleahopper was first described in 1876 from specimens collected in Texas. It has been a serious pest of cotton in many cotton-growing areas of the United States since 1920 (Lukefahr et al., 1976). While an important pest in many areas, fleahopper populations do not generally reach the proportions necessary to inflict economic damage in Oklahoma, except in some dryland situations (Coppock, 1970).

Lukefahr et al. (1966) established that a glabrous cotton variety was effective in reducing fleahopper populations. Subsequent tests showed that fleahopper populations could be reduced by more than 50 percent with glabrous cottons (Lukefahr et al., 1968, 1970). By using high-gossypol cottons, Lukefahr and Houghtaling (1975) also demonstrated a 50 percent reduction in fleahopper populations when compared with Stoneville 7A. This work paralleled findings of Cowan and Lukefahr (1970) who obtained a 65 percent fleahopper reduction in high-gossypol cotton. When the high-gossypol characteristic was coupled with the nectariless trait, fleahopper populations were further reduced by an additional 10 percent (Lukefahr and Houghtaling, 1975). Therefore, those traits originally selected for resisting the attack of the *Heliothis* complex appear to be additionally effective in decreasing fleahopper damage.

CHAPTER III

MATERIALS AND METHODS, 1976

During the 1976 cotton-growing season, tests were conducted at the Southwestern Agronomy Research Station at Tipton, Oklahoma, and at the South Central Cotton Research Station at Chickasha, Oklahoma. The experiment at Tipton was arranged in a randomized-complete-block design and had five treatments replicated four times. The study area at Tipton was divided into 20 plots, each 60 feet long and 16 rows wide (40 inch row spacing). The experiment at Chickasha also used the randomized-complete-block design, but was replicated only three times. The study area at Chickasha was divided into 15 plots, each 90 feet long and 4 rows wide.

At both locations, the treatments, represented by five experimental varieties of cotton, were Stoneville 213 (the standard), Stoneville 731-N, La. 17801, HG-BR-8-N, and HG-6-1-N. This experimental stock was obtained from Dr. M. J. Lukefahr in Brownsville, Texas. Varieties HG-BR-8-N and HG-6-1-N are both hirsute, nectariless, and high gossypol. In addition, HG-6-1-N is an early maturing variety. Both of these strains originated from single plant selections for a line designated as HG-0-08. This line was developed from a composite of several primitive high gossypol strains (Socorro Island source) that had been crossed with Stoneville 7A nectariless. They were isolated and grown in intercross plots for six generations. After making single plant selections, the strains were grown under selfed condition for four generations (Lukefahr, 1976, private communication).

Stoneville 731-N is a hirsute, nectariless, and normal gossypol strain released in 1977 by Stoneville Pedigreed Seed Company, Stoneville, Mississippi. This strain resembles Stoneville 213, but is nectariless and is said to be earlier maturing (Anonymous, 1977).

La 17801 is a glabrous, nectariless, and normal gossypol variety developed by the Agronomy Department of Louisiana State University. It originated from a cross between Stoneville 7Ane (BC_2) and N. C. Smooth 2 (Jones, 1977, personal communication).

Planting was done at Tipton on May 19, 1976, and at Chickasha on May 24, 1976. All varieties at both test areas were planted at the rate of 20 pounds of seed per acre. All agricultural practices, such as cutting stalks, disking, applying fertilizer, planting, rotary hoeing, and irrigation were performed as done routinely at each station.

Plant stand estimates were made at Tipton during the first week of June. This was done by taking five 5.5-foot plant counts at random from each plot and computing the number of plants per acre. Germination in Chickasha plots was uneven and bare spots were replanted on June 10.

Temik (1.5 lb. A.I. per acre) was applied as a side-dress treatment to the first four rows of each plot at Tipton when the cotton reached the 3-4 leaf stage. Thrips and aphids were counted weekly for three consecutive weeks on June 9, 14, and 23. Twenty plants from each plot were removed and placed in capped one-quart containers. These samples were returned to the laboratory and placed in Burlese funnels overnight. The thrips and aphids collected were placed in gridded petri dishes and counted. This procedure is described by Robinson et al. (1972). At the onset of blooming on July 20, bloom counts were made at Tipton for 21 consecutive days from one Temik-treated row and from a corresponding untreated row in each plot.

At Tipton, D-Vac samples were taken for six consecutive weeks (beginning June 30) after the cotton plants reached the 5-6 leaf stage. Fifty row feet of untreated cotton per plot was sampled. The residue was examined for beneficial arthropods and insect pests. Whole plant examinations were made at Chickasha in lieu of D-Vac sampling.

Guthion was applied to both Tipton and Chickasha plots at the rate of 0.3 lb. A.I. per acre. This treatment was for boll weevil control and to predispose plants for Heliothis outbreaks. Guthion was applied to Tipton plots on July 27 and 29; August 1, 5, 12, 17, and 26; and September 6. Chickasha plots were sprayed July 26 and 30; August 13, 17, and 24; and September 6. Spray applications were made using a John Deere Hi-Cycle 600 travelling 4.5 miles per hour. Four gallons and three pints of spray mixture per acre were applied at 40 pounds pressure with one number eight nozzle per row.

Heliothis egg and larvae counts were taken weekly from three 6.5-foot random sampling points per plot. In addition, 50 squares were collected at random from each plot and examined for bollworm feeding damage and boll weevil feeding and oviposition damage.

A stratified harvest was made at Tipton by picking cotton three times during the season. Picking dates at Tipton were September 23, October 14, and November 11. Cotton was picked in each plot from one Temik-treated row and one untreated row. The cotton was picked only once in Chickasha on November 4.

Analysis of variance of individual beneficial insects, spiders, damaged fruit, Heliothis larvae, Heliothis eggs, and yield were made in the Oklahoma State University Computer Center. Prior to analysis, data were converted to a per acre basis. The Statistical Analysis System Program was used in the data analyses.[1] Differences were considered significant at the 0.05 level of probability.

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[1]The system was designed and implemented by Anthony J. Barr and James H. Goodnight, Department of Statistics, North Carolina State University, Raleigh, North Carolina.

CHAPTER IV

RESULTS AND DISCUSSION

Chickasha, 1976

Predatory Arthropods

Several beneficial arthropod species exhibited varietal preferences in Chickasha in 1976. On August 6, significantly more lacewing eggs were observed on varieties HG-6-1-N and Sto. 731-N than on HG-BR-8-N and La. 17801. This is shown on Table I, p. 44. However, Table II, p. 44, shows that lacewing adults achieved their greatest numbers one week later, on August 13, on Stoneville 213. These two instances represented the only times during the 1976 growing season at Chickasha that predator populations reached significant levels during weekly sampling.

Significant varietal differences in seasonal totals did exist, however. Table VII, p. 46, shows the seasonal mean number of lacewing adults significantly greater in the standard than in Stoneville 731-N, La. 17801, and HG-6-1-N. This parallels the earlier weekly findings of August 13, Table II, p. 44.

An examination of Table VIII, p. 46, shows spiders in the greatest abundance in HG-BR-8-N. The fewest number of spiders was found in La. 17801. Stoneville 213 had significantly more spiders than La. 17801, but significantly fewer spiders than HG-BR-8-N.

Table IX, p. 46, illustrates the seasonal variety of beneficial arthropods. HG-BR-8-N and Sto. 213 had the greatest number of beneficials, while La. 17801 had the fewest.

Fleahoppers

Fleahopper populations remained at a very low level throughout the season at Chickasha. Although seasonal means indicated slightly more fleahoppers in the standard, Sto. 213, a significant difference did not exist between varieties.

The Heliothis Complex

Table IV, p. 45, and Table VI, p. 45, show significant differences between varieties due to Heliothis-damaged fruit on August 20 and September 15. Stoneville 731-N had the highest rate of damage on August 20, while HG-6-1-N had significantly lower damage. On September 15, the standard, Sto. 213, had significantly higher damage than either of the high-gossypol varieties, HG-6-1-N or HG-BR-8-N. This trend is manifested in the seasonal totals found in Table XII, p. 47. Both Sto. 213 and Sto. 731-N had significantly higher Heliothis-damaged fruit seasonal mean numbers than did La. 17801, HG-BR-8-N, or HG-6-1-N. When compared to the standard, Heliothis-damaged fruit was reduced by 47.5 percent in HG-BR-8-N and by 50.3 percent in HG-6-1-N.

Heliothis and boll weevil-damaged fruit were combined throughout the season in the data analyses, but constituted a significant difference between varieties on only one occasion, on August 20. This information is found in Table V, p. 45. The greatest number of damaged fruit was observed in Sto. 731-N and the least damage was seen in HG-BR-8-N and HG-6-1-N.

While *Heliothis* egg numbers and *Heliothis* larval populations were not significantly different between varieties on any sampling date throughout the season, seasonal means bore out some differences. The seasonal means for *Heliothis* eggs is represented in Table X, p. 47. The greatest number of eggs was found on Stoneville 731-N, and the fewest number occurred on La. 17801. The seasonal means for *Heliothis* larvae are given in Table XI, p. 47. Stoneville 213 had significantly more *Heliothis* larvae than HG-BR-8-N and La. 17801.

Yield

Analysis of yield data gathered November 4 from Chickasha indicates that no significant difference between varieties existed. The results from cotton quality testing are given in Table LXXXVI, p. 73.

Tipton, 1976

Plant counts made soon after germination on June 2 showed no significant difference between the number of plants in each plot. Likewise, thrips counts done on June 9, June 14, and June 23 were not significantly different between varieties.

Predatory Arthropods

Figure 2, p. 82, illustrates the mean number of beneficial insects and spiders found on each variety throughout the growing season. The beneficial arthropods category was derived by combining big-eyed bugs; Collops beetles; lacewing eggs, larvae, and adults; hooded flower beetles; lady beetles, nabids; and spiders. During the four weeks prior to insecticide applications, total beneficial arthropod populations were observed to be significantly higher on the standard, Stoneville 213, than on the other varieties. Following the initial insecticide application on July 27, beneficial arthropod populations dropped to levels which were not significantly different from one another.

Although hooded beetle population levels remained fairly low, they exhibited a strong preference for Sto. 213. This is illustrated in Figure 1, p. 81. For five consecutive weeks after sampling began, there were significantly more hooded beetles in Sto. 213 than in the other varieties.

On a few dates other individual beneficial species populations differed significantly among varieties. Big-eyed bugs were found to be present in significantly greater numbers on June 30 and July 21 on Stoneville 213. This difference is represented in Tables XIII and XIV, p. 48. Table XV, p. 48, and Table XVI, p. 49, show that Collops beetles and nabids were also found in significantly greater abundance on Stoneville 213. On dates other than those displayed in tables other species of predatory arthropods were not observed or their numbers were not significantly different among varieties.

Seasonal means of beneficial arthropods are shown on Table XXVII, p. 52. The largest number of predators was again found on the standard, Stoneville 213. Individual seasonal means for a number of beneficial species proved significant. Table XX, p. 50, shows the seasonal mean number of big-eyed bugs in Sto. 213 to be double the seasonal mean number found in any other cotton variety. Collops were also found in greater numbers on the standard. Table XXI, p. 50, illustrates this data. The preference by beneficials is further borne out in Tables XXII, XXIII, and XXIV, p. 51. These tables show significantly greater seasonal means of hooded beetles, lady beetles, and Nabids in Sto. 213 than in the other varieties tested.

Fleahoppers

Fleahopper population levels were minimal throughout the 1976 growing season and weekly samples showed no significant differences between varieties. The seasonal means, however, were significantly different. This data is represented in Table XIX, p. 50. Stoneville 213 had a seasonal mean significantly higher than any other variety except Sto. 731-N. Fleahoppers were reduced by about 67 percent on La. 17801 and by approximately 59 percent and 61 percent on HG-6-1-N and HG-BR-8-N, respectively, when compared to the standard.

The Heliothis Complex

The *Heliothis* complex presented Tipton cotton growers with only slight problems in 1976. Population levels were low and reached economic threshold levels only rarely. Even when research plots were routinely sprayed to inhibit predators and predispose cotton to *Heliothis* attack, only a very light bollworm infestation occurred.

During two dates in August *Heliothis*-damaged fruit analyses showed significant differences. On August 18, as shown in Table XVII, p. 49, the high-gossypol varieties showed the greatest average damage. Table XVIII, p. 49, illustrates *Heliothis*-damaged fruit levels which occurred on August 31. Stoneville 731-N exhibited the greatest fruit damage on that date. However, 4.5 percent damage was the greatest average damage level obtained on either date.

Although the number of *Heliothis* eggs observed in Tipton in 1976 were very low, significant differences between varieties did occur during the season. Figure 4, p. 84, illustrates these differences. Early in the observation period (July 28) *Heliothis* eggs were noted to be significantly more numerous on HG-BR-8-N. During the following week, HG-BR-8-N was succeeded in observed egg numbers by Sto. 213. On August 11 egg numbers were significantly higher on Sto. 731-N. August 11 represented the peak of egg laying, and *Heliothis* egg numbers decreased in following weeks to insignificant levels.

The seasonal means for *Heliothis* eggs, given in Table XXV, p. 52, verify that the largest number of *Heliothis* eggs found during the season occurred on Sto. 731-N. However, the number of eggs on Sto. 731-N differed significantly only with La. 17801, which had the fewest number of eggs observed.

Heliothis larval population levels are illustrated in Figure 3, p. 83. Stoneville 213 and Stoneville 731-N had significantly more *Heliothis* larvae on August 11. Stoneville 731-N again had the highest number of larvae on August 18 and later on August 31. This coincides with *Heliothis* larvae seasonal means given in Table XXVI, p. 52. Again, Sto. 731-N had significantly more *Heliothis* larvae per sample than HG-BR-8-N, HG-6-1-N, or La. 17801. La. 17801 had significantly fewer larvae through the season than did any other variety.

Yield

A stratified harvest was made in Tipton to determine if some varieties matured earlier than others. The initial harvest was made on September 23, and followed by later pickings on October 14 and November

11. Seasonal totals are given on Table LXXXII, p. 71. Stoneville 213 had the greatest number of pounds of lint per acre with 1132 pounds. This figure was significantly different from La. 17801 and HG-BR-8-N, with 860 and 752 pounds of lint per acre, respectively.

Table LXXXIII, p. 71, represents the first harvest as a percentage of the total yield. HG-6-1-N led the way in this category with slightly over 50 percent of its total yield harvested on September 23. This is significantly greater than any other variety. Stoneville 731-N had the least amount of cotton produced on the first picking. Only 14 percent of Sto. 731-N was matured by the first picking. This figure is significantly less than any other variety.

The second harvest of October 14 should be an indicator on which varieties matured at an intermediate rate. The standard, Sto. 213, had the largest yield in the second harvest. This is illustrated in Table LXXXIV, p. 72. Nearly half of Sto. 213's total yield was harvested at this time. This figure differed significantly with both high-gossypol varieties, HG-BR-8-N and HG-6-1-N.

The third harvest is represented in Table LXXXV, p. 72. Stoneville 731-N proved to be the slowest-maturing variety in this test with almost 44 percent of its total yield harvested in the last picking. This is significantly later than all other varieties except La. 17801. From this table, it is evident that HG-6-1-N and Sto. 213 are significantly earlier than the other varieties.

Cotton quality testing was performed on samples collected September 24 and October 14. This data is represented in Tables LXXXVII and LXXXVIII, p. 74 and p. 75, respectively.

CHAPTER V

MATERIALS AND METHODS, 1977

Tests in 1977 were again conducted at Tipton and Chickasha and also at the Sandyland Research Station in Mangum, Oklahoma. Minor material and procedural changes were made in the 1977 experiment. Due to unavailability of seed, La. 17801 was not tested. Since four treatments were to be tested, a Latin Square design was regarded as more favorable than the randomized-complete-block design. Each treatment was replicated four times. The study area at Tipton was divided into 16 plots, each 110 feet long and 16 rows wide. The Chickasha plots were 110 feet long and 8 rows wide, while the Mangum plots were 166 feet long and 8 rows wide.

Cotton was planted May 17 at Tipton at the rate of 21 pounds per acre. Plant counts were made on May 31 to determine the number of plants per acre. Thrips counts were taken on June 8. Beginning June 28, D-Vac samples were taken weekly for four consecutive weeks. One row per plot was sampled by D-Vac equipment. Whole plant examinations (in situ) were begun on June 29 and done weekly for nine weeks. Whole plant examinations consisted of ten 2.5-foot samples taken at random in each plot. One hundred squares were collected from each plot and examined for Heliothis feeding damage and boll weevil feeding and oviposition damage. These squares were collected for seven consecutive weeks beginning July 13. Guthion (0.25 lb. A.I. per acre) was applied on July 28 and August 8 to predispose plants for *Heliothis* infestation.

Although cotton was planted on May 19 at Chickasha, poor germination due to heavy rains forced replanting on June 2. Five 5.5-foot random samples per plot were taken to determine the number of plants per acre on June 22. Five random 2.5-foot whole plant exams per plot were first begun on July 6 and made for the next eight weeks. One hundred squares from each plot were checked weekly for five weeks, beginning August 3.

Since the station at Mangum lacked irrigation facilities, the experimental varieties were planted there to test their abilities to endure dryland conditions. Planting was done on June 14 and whole plant exams began on July 13 and continued for the next five weeks.

Yield data was collected by picking 50 row feet of cotton from a row near the center of each plot. Two pickings were made in Tipton on September 22 and December 2. A single picking was made at Mangum on December 2 and at Chickasha on November 20. Samples were returned to Stillwater where they were weighed, ginned, and quality-tested.

As in 1976, analyses of variance were performed on the data at the Oklahoma State University Computer Center. Data analyzed included beneficial insects, spiders, fruit damage, *Heliothis* larvae, *Heliothis* eggs, and yield.

CHAPTER VI

RESULTS AND DISCUSSION

Chickasha, 1977

Predatory Arthropods

Lacewing egg means were significantly different on two sampling dates in 1977. Table XXVIII, p. 53, shows that the greatest number of lacewing eggs were observed in HG-BR-8-N on July 26. One week later, on August 2, the greatest number of eggs were found on the standard, Sto. 213. This data is shown in Table XXIX, p. 53. Lacewing adults were found to occur in significantly different numbers on August 23. Table XXX, p. 53, shows that there were significantly more lacewing adults found in Sto. 213 than in either HG-6-1-N or HG-BR-8-N. Seasonal totals of lacewing adults, found in Table XXXV, p. 55, indicate the same trend. Significantly more adult lacewings were found in Sto. 213 than in HG-6-1-N or HG-BR-8-N.

Table XXXI, p. 54, gives the mean values for lady beetles on August 2. Here again, Sto. 213 had significantly more lady beetles than HG-6-1-N or HG-BR-8-N. Seasonal means for lady beetles, shown in Table XXXVI, p. 55, are significantly higher for Sto. 213 than in the other varieties.

Trends in beneficial arthropod levels between varieties are illustrated in Figure 6, p. 86. Although beneficial levels followed the same basic trend among varieties throughout the season, significant differences occurred on July 26, August 10, and August 23. HG-BR-8-N had significantly more beneficial arthropods present than Sto. 731-N on July 26. There were significantly more beneficials found on Sto. 213 on August 10 and August 23. Seasonal means, given in Table XXXVII, p. 56, show that Sto. 213 had significantly greater numbers of beneficial arthropods than any of the other varieties.

Fleahoppers

Figure 5, p. 85, illustrates mean numbers of fleahoppers observed during the 1977 growing season in Chickasha. Fleahopper populations peaked about July 26. Their numbers declined steadily until an insecticide application was made on August 8. At this time, fleahopper levels dwindled to insignificant levels. During the first five sampling dates, significant differences existed. Stoneville 213 had significantly more fleahoppers than the other varieties on July 6, 13, 19, and 26. On August 2, Sto. 213 was not significantly different from Sto. 731-N but was significantly different from both high-gossypol varieties.

When seasonal means were evaluated, In Table XXXIV, p. 55, differences among varieties were highly significant. Stoneville 213 proved to have more fleahoppers than any other variety. When compared to the standard, fleahopper numbers were reduced by about 45 percent in Sto. 731-N, by about 52 percent in HG-BR-8-N, and by about 60 percent in HG-6-1-N.

The Heliothis Complex

Seasonal observations of *Heliothis* larvae are given in Figure 7, p. 87. Population trends were somewhat erratic, but significant differences between varieties occurred on the last three sampling dates. Stoneville 731-N had significantly more *Heliothis* larvae than the other varieties on August 2. *Heliothis* larvae were significantly more numerous on Sto. 213 than on HG-6-1-N and HG-BR-8-N on August 10. Both Sto. 213 and Sto. 731-N had significantly more larvae on August 15 than either of the high-gossypol varieties.

The seasonal means for *Heliothis* larvae, found in Table XXXVIII, p. 56, show significant differences. Stoneville 213 had significantly greater numbers of larvae than either HG-6-1-N or HG-BR-8-N. HG-6-1-N had only about 44 percent as many larvae as Sto. 213, and HG-BR-8-N had only about 51 percent as many.

Significant varietal differences in *Heliothis*-damaged fruit numbers arose twice during the season. In Table XXXII, p. 54, Sto. 213 had significantly more fruit damage than the other varieties on August 10. Two weeks later, on August 23, both Sto. 731-N and Sto. 213 showed high levels of damage, and both were significantly different from HG-6-1-N and HG-BR-8-N. This is shown in Table XXXIII, p. 54.

When seasonal *Heliothis*-damaged fruit means were analyzed in Table XXXIX, p. 56, they proved to be highly significant. Stoneville 731-N had significantly more damage than either HG-6-1-N or HG-BR-8-N. HG-BR-8-N showed a significantly lower damage level than Sto. 731-N or Sto. 213. Compared to the standard, Sto. 731-N had almost 9 percent more damage. Damaged fruit was reduced in HG-6-1-N by about 45 percent and by about 47 percent in HG-BR-8-N.

Yield

Analysis of yield data showed Chickasha to be the only location in

1977 to exhibit significant yield differences among varieties. Results of this experiment show that HG-6-1-N produced significantly more pounds of lint per acre than did HG-BR-8-N. This data is found in Table XCIII, p. 79.

Mangum, 1977

Predatory Arthropods

Due to dry growing conditions and limited cotton growth associated with these conditions, insect levels remained very low throughout the 1977 growing season at Mangum. Spiders were the only beneficial arthropods to differ significantly among varieties during the season. Table XLI, p. 57, shows that the mean number of spiders observed were highest in HG-BR-8-N. This mean was significantly different only from that of HG-6-1-N.

Fleahoppers

No significant difference existed between varieties in fleahopper numbers during the 1977 season at Mangum.

The Heliothis Complex

Like the beneficial arthropods, *Heliothis* populations were also very low at Mangum. Table XL, p. 57, indicates that *Heliothis* egg numbers were significantly different on July 14. Stoneville 731-N had a significantly greater number of eggs than Sto. 213. Likewise, *Heliothis* larvae were significantly greater in number in Sto. 731-N than Sto. 213 on August 22. The mean separation of this data is found in Table XLII, p. 57.

Yield

Analysis of yield data gathered in 1977 from Mangum indicated that no significant differences among varieties existed. However, because all four varieties performed poorly without irrigation, this yield data probably does not contribute to an accurate picture of varietal resistance. Cotton quality results from Mangum can be found in Table XCI, p. 78.

Tipton, 1977

Preliminary testing included plant counts to determine whether significant differences existed between varieties. Plant counts were made on May 31, showing that the number of plants per plot were not significantly different. Thrips counts made on June 8 showed that thrips populations were extremely low and not significantly different between varieties.

Predatory Arthropods

Beneficial arthropod data was collected early in the season by two sampling methods. Initial data collection utilized the D-Vac apparatus. Later, sampling was done by whole plant exams (in situ).

On various D-Vac sampling dates throughout the season, individual beneficial species exhibited significant differences between varieties. Lady beetles, hooded beetles, nabids, and spiders, as shown in Tables XLIV, XLV, XLVI, and XLVII, pp. 58 and 59, were found in significantly greater numbers on Sto. 213 on July 12 and July 19. These data are represented in Tables XLIX and LI, p. 60. Although populations of hooded beetles and lady beetles were low, both were present in significantly greater numbers in the standard. Tables XLVIII and L, pp. 59 and 60, illustrate these means.

Seasonal means of D-Vac samples followed the same pattern. Tables LV, LVI, and LVII, p. 62, show Sto. 213 to be significantly more attractive to hooded beetles, lady beetles, and nabids. Big-eyed bugs were also found in greater abundance on Sto. 213. However, big-eyed bug levels were significantly different only between Sto. 213 and Sto. 731-N. This is shown in Table LIII, p. 61. Table XLIII, p. 58, shows significantly more big-eyed bugs in Sto. 213.

Figure 9, p. 89, illustrates the mean number of beneficial arthropods sampled by D-Vac in Tipton. Stoneville 213 contained beneficials in significantly greater numbers on July 5, 12, and 19. Seasonal means for total beneficial arthropods were again significantly greater in the standard, Sto. 213. These results are given in Table LVII, p. 62. When compared to Sto. 213, beneficial arthropod populations were reduced by about 42 percent in HG-6-1-N, 44.5 percent in Sto. 731-N, and 46 percent in HG-BR-8-N.

Whole plant examinations done in Tipton also provided instances when beneficial arthropod levels differed significantly between varieties. Collops beetle populations showed significant varietal differences on three dates. This is represented in Tables LVIII, LX, and LXIII, pp. 63 and 64. Collops beetles never achieved high population levels but were found in greatest numbers on Sto. 213 during the first two dates, July 13 and July 20. Later in the season, on August 24, they were more prevalent on the high-gossypol varieties, especially on HG-6-1-N. No significant seasonal mean differences occurred in Collops beetles.

Tables XXXIX, LXI, LXII, and LXIV, pp. 56, 64, and 65, show mean separations for lacewing eggs on July 13, August 3, August 10, and August 24. Most lacewing eggs were found on Sto. 213 for each date, and the fewest number were found on Sto. 731-N and HG-6-1-N. In addition, the seasonal mean, given in Table LXXIV, p. 68, gave the same results. Stoneville 213 had the highest number of lacewing eggs found, and HG-6-1-N had significantly fewer lacewing eggs than any other variety. Although weekly averages were not significant, the seasonal means for lacewing adults paralleled those for lacewing eggs. The variety HG-6-1-N had significantly fewer lacewing adults than did Sto. 213. This is shown in Table LXXV, p. 68.

Significant differences occurred between varieties for lady beetles on June 29 and July 6. This is shown in Tables LXV and LXVII, pp. 65 and 66, respectively. Stoneville 731-N and HG-BR-8-N had significantly more lady beetles than the other varieties on July 6. No significant difference between varieties in the number of lady beetles occurred in the seasonal totals.

Tables LXVI and LXX, pp. 65 and 67, show that nabids reached significantly different levels during the season. On June 29, Sto. 731-N had significantly more nabids than HG-BR-8-N. On August 10, Sto. 731-N had significantly more nabids than HG-6-1-N. Nabid populations were relatively low throughout the season and significant differences between varieties did not occur in seasonal totals.

Spiders were found in significantly greater abundance in Sto. 213 on two sampling dates, July 13 and July 20. This is given in Tables LXVIII and LXIX, p. 66. On July 13, the high-gossypol varieties had significantly fewer spiders than Sto. 213. Stoneville 731-N had significantly fewer spiders than Sto. 213 on July 20. Stoneville 213 had significantly more spiders than any other variety in the seasonal total analysis, given in Table LXXVII, p. 69.

During the first three weeks that samples were made, hooded beetles reached their population peaks. Figure 11, p. 91, refers to this. The greatest numbers of hooded beetles were found in Sto. 213. These levels were significantly greater in the standard on June 29, July 6, and July 13. Following insecticide applications, hooded beetle populations were reduced until significant differences did not occur between varieties. Seasonal totals indicate that significantly more hooded beetles were found in Sto. 213 than in the other varieties. This information is found in Table LXXVI, p. 69.

Although their numbers were few, big-eyed bugs also showed significant varietal differences in the seasonal means. Table LXXIII, p. 68, illustrates that Sto. 213 had significantly more big-eyed bugs than HG-6-1-N.

Beneficial arthropod levels are illustrated in Figure 12, p. 92. Beneficial arthropod populations peaked around July 27 prior to insecticide applications made to predispose the cotton plants to Heliothis infestation. Late in the season, on August 24, a second peak was reached approximately two weeks following the last insecticide application. The greatest number of beneficials appeared to be on Sto. 213 and HG-BR-8-N throughout the season. Significant differences between varieties occurred on June 29, July 13, July 20, August 3, and August 24. Seasonal means showed that significantly more beneficials were found on Sto. 213 than on any other variety. It is also apparent that HG-6-1-N had significantly fewer beneficials than the other varieties. This data is depicted on Table LXXVIII, p. 69.

Fleahoppers

Fleahopper samples obtained by the D-Vac apparatus proved significantly different on three of four sampling dates. Figure 8, p. 88, illustrates this. On June 28, July 5, and July 19, fleahoppers were significantly more numerous in samples collected from Sto. 213.

Whole plant examinations indicated that fleahopper populations peaked about July 13. During the first four sampling dates, significant differences in fleahopper numbers occurred. This is shown in Figure 10, p. 90. On June 29, July 6, July 13, and July 20, fleahoppers were significantly more numerous in Sto. 213. Fleahopper numbers declined steadily throughout the season and became negligible after the first insecticide application on July 29. Seasonal means, given in Table LXXII, p. 67, show that fleahoppers were significantly more prevalent in Sto. 213 than the other tested varieties.

The Heliothis Complex

The year 1977 was more successful for obtaining a *Heliothis* infestation at Tipton. Figure 13, p. 93, illustrates the mean number of *Heliothis* eggs per variety on each sampling date. The greatest number of eggs was observed on August 3 during the season's peak oviposition period. On four dates, July 6, July 20, August 3, and August 24, significant differences existed between varieties. Stoneville 731-N had significantly more *Heliothis* eggs than the other varieties on July 6, July 20, and August 3. On August 24, Sto. 213 had the greatest number of eggs. Meanwhile, HG-6-1-N consistently had the fewest number of eggs throughout the season. Seasonal means, given in Table LXXIX, p. 70, bear this out. Stoneville 731-N and Sto. 213 had significantly more

Heliothis eggs than did HG-6-1-N. Compared to Sto. 731-N, the eggs found on HG-6-1-N were reduced by about 42 percent.

Heliothis larvae reached their highest population levels about one week after the peak oviposition period of August 3. Again, on dates when significant differences occurred (August 3, August 10, and August 24) Sto. 731-N had the highest number of Heliothis larvae. The high-gossypol varieties usually had one-half or less the number of larvae found on Sto. 731-N. Table LXXX, p. 70, provides the seasonal means for each variety. Stoneville 731-N had significantly more larvae than either HG-BR-8-N or HG-6-1-N. Stoneville 731-N had about 40 percent more larvae than the standard, Sto. 213, throughout the season. When HG-BR-8-N and HG-6-1-N were compared to Sto. 213, they showed larval reductions of about 31 and 40 percent, respectively.

As would be expected, Heliothis-damaged fruit numbers peaked about one week following the larval population peak. Figure 15, p. 95, illustrates this trend. Significant differences between varieties occurred on July 13, August 3, and August 10. The damage trend was similar to that of Heliothis larvae in that most of the fruit damage was observed in Sto. 731-N and Sto. 213. Analysis of the seasonal means, however, indicated no significant difference between varieties.

The combined boll weevil/Heliothis-damaged fruit category exhibited significant differences on August 10, as shown in Table LXXI, p. 67. On this date, both HG-BR-8-N and HG-6-1-N had significantly less total damage than Sto. 213. This is further shown by seasonal means, Table LXXXI, p. 70. Again, HG-BR-8-N and HG-6-1-N had less damage, but were significantly different from Sto. 731-N.

Yield

No significant difference in yield existed among varieties planted at Tipton in 1977. In neither the first harvest of September 19, nor the second harvest of December 2, were there significant differences in pounds of lint per acre. There was also no significant difference in the combined harvests, i.e. the total yield. However, when the first harvest was taken as a percentage of the total (in order to determine earliness), Sto. 731-N was found to be the earliest maturing variety. It was not, however, significantly earlier than HG-6-1-N. These results are given in Table XCII, p. 79. Cotton quality results for the first and second harvests are given in Tables LXXXIX and XC, pp. 76 and 77, respectively.

CHAPTER VII

SUMMARY

This experiment attempted to determine if significant differences in beneficial arthropod populations, fleahopper populations, Heliothis egg and larval numbers, Heliothis-damaged fruit numbers, and yield existed among cotton varieties bred for Heliothis resistance. Five varieties, Sto. 213, Sto. 731-N, La. 17801, HG-BR-8-N, and HG-6-1-N, were tested in one southcentral and one southwestern Oklahoma locations in 1976. These same varieties, except La. 17801 which was not available, were again tested in one location in southcentral Oklahoma and two locations in southwestern Oklahoma in 1977. Stoneville 213, a commercial variety, was used as a standard for comparison.

Generally, in each test, Sto. 213 harbored the greatest number of beneficial arthropods. Unfortunately, this experiment was not designed to determine whether resistance traits of the tested experimental varieties were directly responsible for lowering beneficial insect populations or if this was simply a result of decreased prey populations within the resistant varieties. In the 1977 test in Tipton, beneficial arthropod populations were reduced by 41-46 percent in the Heliothis-damaged varieties.

When fleahopper populations reached appreciable numbers, significant reductions were noted in some of the experimental varieties. In Tipton in 1976 fleahopper numbers were reduced by about 67 percent in the only glabrous variety tested, La. 17801. This is a somewhat greater reduction in fleahoppers than the 60 percent reduction reported by Lukefahr et al. (1968, 1970) in similar experiments using glabrous cottons.

When compared to the standard, fleahopper populations were reduced by 59-61 percent in HG-BR-8-N and HG-6-1-N in Tipton in 1976. During 1977 at Tipton fleahopper populations showed similar reductions of 52-58 percent. These varieties are hirsute, nectariless, and high-gossypol. These findings parallel work done by Lukefahr and Houghtaling (1975) and Cowan and Lukefahr (1970). They reported reductions of 60-65 percent in cottons which combined the high-gossypol and nectariless traits. This trend was duplicated in Chickasha in 1977 when HG-BR-8-N and HG-6-1-N were shown to have 52-60 percent fewer fleahoppers than the standard, Sto. 213.

When Heliothis egg data was analyzed in each test, a trend appeared to develop. The greatest egg numbers fluctuated mainly between Sto. 213 and Sto. 731-N. In 1976 egg numbers were significantly greater in Sto. 731-N than in La. 17801 at both locations. A remarkable reduction of about 72-75 percent fewer eggs were found in La. 17801 than in Sto. 731-N. These results are similar to those of Lukefahr et al. (1965) who reported 60 percent in glabrous cottons.

No significant seasonal differences in egg numbers were noted in Chickasha or Mangum in 1977. However, both Sto. 213 and Sto. 731-N had greater seasonal numbers of Heliothis eggs than HG-6-1-N in Tipton during the same time.

Heliothis larval populations were significantly reduced on resistant varieties in several tests. Larvae numbers in Chickasha during the

1976 season were reduced by 61.5 percent in both HG-BR-8-N and La. 17801 when compared to the standard. The reduction in HG-BR-8-N is almost identical to the 60 percent larvae reduction in high-gossypol cottons noted by Lukefahr and Houghtaling (1969). Reduced larval numbers in La. 17801 correspond with results obtained by Lukefahr et al. (1965). Their results showed larval reductions of up to 80 percent in cottons combining the glabrous and nectariless characteristics.

In other tests HG-6-1-N and HG-BR-8-N compared very favorably in reducing Heliothis larval populations. In Chickasha during the 1977 season, larvae numbers were reduced by 56 percent on HG-6-1-N and by 49 percent on HG-BR-8-N when compared to the standard. In Tipton during the 1977 season, HG-BR-8-N had 31 percent fewer larvae than Sto. 213, and HG-6-1-N had 40 percent fewer larvae.

Only Sto. 731-N failed to show fewer larvae than the standard. In no test was there a significant difference between the two. In fact, seasonal means from Tipton in 1976 indicate that there were 47 percent more larvae found on Sto. 731-N than were found on Sto. 213. This is also represented in the seasonal means of the 1977 season at Tipton. In this test, Sto. 731-N had 40 percent more larvae than Sto. 213.

Since Heliothis populations remained low throughout 1976, seasonal means of Heliothis-damaged fruit were not significantly different. However, in Chickasha in 1977 Heliothis-damaged fruit exhibited reductions of about 45 percent in HG-6-1-N and about 47 percent in HG-BR-8-N. Also, during this test Sto. 731-N was shown to have almost 9 percent more damaged fruit than the standard. Data from Tipton in 1977 indicated that levels of Heliothis-damaged fruit were higher in Sto. 213 and Sto. 731-N on three sampling dates, but no seasonal differences among varieties existed.

Yield data was obtained with three objectives in mind. First, it was necessary to know if varietal differences in amount of yield existed. Yield was also used as a measure of earliness. Finally, yield samples were used to determine whether differences in quality existed among varieties.

In terms of pounds of lint per acre, Sto. 213 had a significantly higher yield than La. 17801 or HG-BR-8-N in 1976 in Tipton. During 1977 in Chickasha, a significant difference in yield existed between HG-6-1-N and HG-BR-8-N. No significant differences in yield among varieties occurred in the other test locations during 1976 or 1977.

HG-6-1-N appears to be a much earlier maturing variety than any other tested in the 1976 yield data from Tipton. This data also indicates that Sto. 731-N was considerably later in maturity than the other varieties in 1976. However, in testing done in Tipton during 1977, Sto. 731-N was the earliest maturing variety and was significantly earlier than all other varieties except HG-6-1-N. This 1977 data may have been significantly altered by a hail storm prior to harvest. The loss, estimated at 25-40 percent, damaged most open bolls and could have seriously influenced the results of this test.

Quality did not differ greatly among samples gathered in Tipton, Chickasha, or Mangum during 1976 and 1977.

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APPENDIX A

TABLE I

LACEWING EGGS, CHICKASHA, AUGUST 6, 1976

	Variety	Mean
	HG-6-1-N	3.67 a*
	Sto. 731-N	3.33 a
	Sto. 231	1.33 ab
	HG-BR-8-N	0.67 b
	La. 17801	0.33 b
$LSD_{.05} = 2.42$		

*Values followed by the same letter do not differ significantly at the 5% level by Duncan's New Multiple Range Test.

TABLE II

LACEWING ADULTS, CHICKASHA, AUGUST 13, 1976

	Variety	Mean
	Sto. 213	1.67 a
	Sto. 731-N	0.33 b
	La. 17801	0.00 b
	HG-BR-8-N	0.00 b
	HG-6-1-N	0.00 b
$LSD_{.01} = 0.94$		

TABLE III

HELIOTHIS EGGS, CHICKASHA, JULY 22, 1976

	Variety	Mean
	Sto. 731-N	2.33 a
	HG-BR-8-N	2.33 a
	Sto. 213	0.67 b
	La. 17801	0.67 b
	HG-6-1-N	0.00 b
$LSD_{.05} = 1.31$		

TABLE IV

HELIOTHIS DAMAGE, CHICKASHA, AUGUST 20, 1976

Variety	Mean
Sto. 731-N	10.67 a
Sto. 213	9.67 ab
HG-BR-8-N	7.67 ab
La. 17801	7.33 ab
HG-6-1-N	5.33 b

$LSD_{.05} = 4.94$

TABLE V

BOLL WEEVIL/*HELIOTHIS*-DAMAGED FRUIT, CHICKASHA, AUGUST 20, 1976

Variety	Mean
Sto. 731-N	14.67 a
La. 17801	12.00 ab
Sto. 213	9.00 bc
HG-BR-8-N	7.00 c
HG-6-1-N	5.67 c

$LSD_{.01} = 4.29$

TABLE VI

HELIOTHIS-DAMAGED FRUIT, CHICKASHA, SEPTEMBER 15, 1976

Variety	Mean
Sto. 213	10.33 a
Sto. 731-N	9.33 ab
La. 17801	4.67 ab
HG-6-1-N	4.33 b
HG-BR-8-N	2.67 c

$LSD_{.05} = 5.77$

TABLE VII

LACEWING ADULTS, CHICKASHA, 1976

Variety	Seasonal Mean
Sto. 213	0.33 a
HG-BR-8-N	0.14 ab
Sto. 731-N	0.10 b
La. 17801	0.05 b
HG-6-1-N	0.00 b

$LSD_{.05} = 0.20$

TABLE VII

SPIDERS, CHICKASHA, 1976

Variety	Seasonal Mean
HG-BR-8-N	0.48 a
HG-6-1-N	0.29 ab
Sto. 731-N	0.29 ab
Sto. 213	0.14 bc
La. 17801	0.05 c

$LSD_{.05} = 0.22$

TABLE IX

BENEFICIAL ARTHROPODS, CHICKASHA, 1976

Variety	Seasonal Mean
HG-BR-8-N	8.86 a
Sto. 213	7.43 a
Sto. 731-N	6.81 ab
HG-6-1-N	6.14 ab
La. 17801	3.76 b

$LSD_{.05} = 3.46$

TABLE X

HELIOTHIS EGGS, CHICKASHA, 1976

Variety	Seasonal Mean
Sto. 731-N	3.05 a
HG-BR-8-N	2.38 ab
Sto. 213	2.29 abc
HG-6-1-N	1.48 bc
La. 17801	0.76 c

$LSD_{.05} = 1.57$

TABLE XI

HELIOTHIS LARVAE, CHICKASHA, 1976

Variety	Seasonal Mean
Sto. 213	3.33 a
Sto. 731-N	2.86 ab
HG-6-1-N	1.71 ab
HG-BR-8-N	1.29 b
La. 17801	1.29 b

$LSD_{.01} = 1.97$

TABLE XII

HELIOTHIS-DAMAGED FRUIT, CHICKASHA, 1976

Variety	Seasonal Mean
Sto. 213	6.56 a
Sto. 731-N	6.04 a
La. 17801	3.70 b
HG-BR-8-N	3.44 b
HG-6-1-N	3.26 b

$LSD_{.01} = 2.15$

TABLE XII

BIG-EYED BUGS, TIPTON, JUNE 30, 1976

Variety	Mean
Sto. 213	0.75 a
Sto. 731-N	0.00 b
La. 17801	0.00 b
HG-BR-8-N	0.00 b
HG-6-1-N	0.00 b

$LSD_{.01} = 0.48$

TABLE XIV

BIG-EYED BUGS, TIPTON, JULY 21, 1976

Variety	Mean
Sto. 213	2.00 a
HG-BR-8-N	0.50 b
HG-6-1-N	0.25 b
La. 17801	0.00 b
Sto. 731-N	0.00 b

$LSD_{.05} = 1.32$

TABLE XV

COLLOPS BEETLES, TIPTON, JULY 21, 1976

Variety	Mean
Sto. 213	4.25 a
HG-6-1-N	2.25 ab
HG-BR-8-N	0.75 b
La. 17801	0.50 b
Sto. 731-N	0.25 b

$LSD_{.01} = 2.27$

TABLE XVI

NABIDS, TIPTON, JULY 21, 1976

Variety	Mean
Sto. 213	2.50 a
HG-6-1-N	1.00 b
La. 17801	0.50 b
Sto. 731-N	0.50 b
HG-BR-8-N	0.25 b

$LSD_{.05} = 1.35$

TABLE XVII

<u>HELIOTHIS</u>-DAMAGED FRUIT, TIPTON, AUGUST 18, 1976

Variety	Mean
HG-BR-8-N	2.25 a
HG-6-1-N	1.25 ab
Sto. 731-N	0.75 b
Sto. 213	0.50 b
La. 17801	0.50 b

$LSD_{.05} = 1.20$

TABLE XVIII

<u>HELIOTHIS</u>-DAMAGED FRUIT, TIPTON, AUGUST 31, 1976

Variety	Mean
Sto. 731-N	2.25 a
HG-6-1-N	1.00 ab
La. 17801	0.25 b
Sto. 213	0.25 b
HG-BR-8-N	0.00 b

$LSD_{.01} = 1.82$

TABLE XIX

FLEAHOPPERS, TIPTON, 1976

	Variety	Seasonal Mean
	Sto. 213	2.13 a
	Sto. 731-N	1.04 ab
	HG-6-1-N	0.88 b
	HG-BR-8-N	0.83 b
	La. 17801	0.71 b
$LSD_{.05} = 1.17$		

TABLE XX

BIG-EYED BUGS, TIPTON, 1976

	Variety	Seasonal Mean
	Sto. 213	0.67 a
	HG-6-1-N	0.33 ab
	HG-BR-8-N	0.25 ab
	Sto. 731-N	0.13 b
	La. 17801	0.08 b
$LSD_{.01} = 0.42$		

TABLE XXI

COLLOPS BEETLES, TIPTON, 1976

	Variety	Seasonal Mean
	Sto. 213	1.58 a
	HG-6-1-N	0.92 ab
	HG-BR-8-N	0.54 b
	Sto. 731-N	0.46 b
	La. 17801	0.46 b
$LSD_{.01} = 0.80$		

TABLE XXII

HOODED BEETLES, TIPTON, 1976

Variety	Seasonal Mean
Sto. 213	5.42 a
La. 17801	1.42 b
HG-BR-8-N	1.08 b
HG-6-1-N	0.54 b
Sto. 731-N	0.38 b

$LSD_{.01} = 2.52$

TABLE XXIII

LADY BEETLES, TIPTON, 1976

Variety	Seasonal Mean
Sto. 213	2.54 a
HG-BR-8-N	1.25 b
Sto. 731-N	1.00 b
La. 17801	0.83 b
HG-6-1-N	0.58 b

$LSD_{.05} = 1.21$

TABLE XXIV

NABIDS, TIPTON, 1976

Variety	Seasonal Mean
Sto. 213	1.42 a
HG-6-1-N	0.92 ab
HG-BR-8-N	0.67 b
La. 17801	0.63 b
Sto. 731-N	0.50 b

$LSD_{.05} = 0.68$

TABLE XXV

HELIOTHIS EGGS, TIPTON, 1976

Variety	Seasonal Mean
Sto. 731-N	2.04 a
Sto. 213	1.89 a
HG-BR-8-N	1.82 a
HG-6-1-N	1.25 a
La. 17801	0.57 b

$LSD_{.01} = 0.94$

TABLE XXVI

HELIOTHIS LARVAE, TIPTON, 1976

Variety	Seasonal Mean
Sto. 731-N	1.68 a
Sto. 213	1.14 ab
HG-BR-8-N	0.79 bc
HG-6-1-N	0.68 bc
La. 17801	0.46 c

$LSD_{.01} = 0.91$

TABLE XXVII

BENEFICIAL ARTHROPODS, TIPTON, 1976

Variety	Seasonal Mean
Sto. 213	13.29 a
HG-BR-8-N	5.92 b
La. 17801	5.08 b
HG-6-1-N	4.63 b
Sto. 731-N	4.21 b

$LSD_{.01} = 5.13$

TABLE XXVIII

LACEWING EGGS, CHICKASHA, JULY 26, 1977

	Variety	Mean
	HG-BR-8-N	10.50 a
	HG-6-1-N	4.75 b
	Sto. 213	3.50 b
	Sto. 731-N	3.25 b
$LSD_{.01} = 5.46$		

TABLE XXIX

LACEWING ADULTS, CHICKASHA, AUGUST 2, 1977

	Variety	Mean
	Sto. 213	1.25 a
	HG-6-1-N	0.25 b
	HG-BR-8-N	0.00 b
	Sto. 731-N	0.00 b
$LSD_{.05} = 0.71$		

TABLE XXX

LACEWING ADULTS, CHICKASHA, AUGUST 23, 1977

	Variety	Mean
	Sto. 213	1.50 a
	Sto. 731-N	0.50 ab
	HG-6-1-N	0.25 b
	HG-BR-8-N	0.00 b
$LSD_{.05} = 1.09$		

TABLE XXXI

LADY BEETLES, CHICKASHA, AUGUST 2, 1977

Variety	Mean
Sto. 213	3.75 a
Sto. 731-N	2.25 ab
HG-6-1-N	1.25 b
HG-BR-8-N	1.00 b

$LSD_{.05}$ -2.43

TABLE XXXII

HELIOTHIS-DAMAGED FRUIT, CHICKASHA, AUGUST 10, 1977

Variety	Mean
Sto. 213	5.25 a
Sto. 731-N	4.25 ab
HG-6-1-N	3.00 b
HG-BR-8-N	2.50 b

$LSD_{.05}$ = 1.93

TABLE XXXIII

HELIOTHIS-DAMAGED FRUIT, CHICKASHA, AUGUST 23, 1977

Variety	Mean
Sto. 731-N	29.00 a
Sto. 213	28.25 a
HG-6-1-N	14.00 b
HG-BR-8-N	11.75 b

$LSD_{.01}$ = 11.68

TABLE XXXIV

FLEAHOPPERS, CHICKASHA, 1977

	Variety	Seasonal Mean
	Sto. 213	8.53 a
	Sto. 731-N	4.68 b
	HG-BR-8-N	4.09 b
	HG-6-1-N	3.41 b
$LSD_{.01} = 3.29$		

TABLE XXXV

LACEWING ADULTS, CHICKASHA, 1977

	Variety	Seasonal Mean
	Sto. 213	0.56 a
	Sto. 731-N	0.16 b
	HG-6-1-N	0.16 b
	HG-BR-8-N	0.13 b
$LSD_{.01} = 0.19$		

TABLE XXXVI

LADY BEETLES, CHICKASHA, 1977

	Variety	Seasonal Mean
	Sto. 213	1.56 a
	Sto. 731-N	0.94 b
	HG-6-1-N	0.75 b
	HG-BR-8-N	0.72 b
$LSD_{.05} = 0.57$		

TABLE XXXVII

BENEFICIAL ARTHROPODS, CHICKASHA, 1977

Variety	Seasonal Mean
Sto. 213	12.16 a
HG-BR-8-N	9.94 b
Sto. 731-N	9.72 b
HG-6-1-N	8.56 b

$LSD_{.05} = 1.98$

TABLE XXXVIII

HELIOTHIS LARVAE, CHICKASHA, 1977

Variety	Seasonal Mean
Sto. 213	2.56 a
Sto. 731-N	2.22 ab
HG-BR-8-N	1.31 bc
HG-6-1-N	1.12 c

$LSD_{.05} = 0.93$

TABLE XXXIX

HELIOTHIS-DAMAGED FRUIT, CHICKASHA, 1977

Variety	Seasonal Mean
Sto. 731-N	13.05 a
Sto. 213	12.00 ab
HG-6-1-N	6.53 bc
HG-BR-8-N	6.35 c

$LSD_{.01} = 5.56$

TABLE XL

HELIOTHIS EGGS, MANGUM, JULY 14, 1977

Variety	Mean
Sto. 731-N	1.75 a
HG-BR-8-N	1.25 ab
HG-6-1-N	0.50 ab
Sto. 213	0.25 b

$LSD_{.05} = 1.30$

TABLE XLI

SPIDERS, MANGUM, AUGUST 12, 1977

Variety	Mean
HG-BR-8-N	1.50 a
Sto. 213	1.00 ab
Sto. 731-N	0.75 ab
HG-6-1-N	0.00 b

$LSD_{.05} = 1.09$

TABLE XLII

HELIOTHIS LARVAE, MANGUM, AUGUST 22, 1977

Variety	Mean
Sto. 731-N	3.75 a
HG-BR-8-N	2.50 ab
HG-6-1-N	2.00 ab
Sto. 213	0.50 b

$LSD_{.05} = 2.81$

TABLE XLIII

BIG-EYED BUGS, TIPTON, JULY 5, 1977 (D-Vac)

Variety	Mean
Sto. 213	1.00 a
Sto. 731-N	0.00 b
HG-BR-8-N	0.00 b
HG-6-1-N	0.00 b
$LSD_{.05}$ = 0.71	

TABLE XLIV

LADY BEETLES, TIPTON, JULY 5, 1977 (D-Vac)

Variety	Mean
Sto. 213	3.25 a
HG-BR-8-N	0.75 b
HG-6-1-N	0.00 b
Sto. 731-N	0.00 b
$LSD_{.05}$ = 2.34	

TABLE XLV

HOODED BEETLES, TIPTON, JULY 5, 1977 (D-Vac)

Variety	Mean
Sto. 213	2.75 a
Sto. 731-N	0.50 b
HG-BR-8-N	0.50 b
HG-6-1-N	0.00 b
$LSD_{.05}$ = 1.92	

TABLE XLVI

NABIDS, TIPTON, JULY 5, 1977 (D-Vac)

	Variety	Mean
	Sto. 213	25.00 a
	HG-BR-8-N	15.75 ab
	HG-6-1-N	10.75 b
	Sto. 731-N	9.50 b
$LSD_{.05}$ = 13.54		

TABLE XLVII

SPIDERS, TIPTON, JULY 5, 1977 (D-Vac)

	Variety	Mean
	Sto. 213	30.50 a
	HG-6-1-N	19.75 b
	Sto. 731-N	16.50 b
	HG-BR-8-N	13.75 b
$LSD_{.01}$ = 8.39		

TABLE XLVIII

LADY BEETLES, TIPTON, JULY 12, 1977 (D-Vac)

	Variety	Mean
	Sto. 213	2.50 a
	HG-BR-8-N	0.50 b
	HG-6-1-N	0.25 b
	Sto. 731-N	0.00 b
$LSD_{.01}$ = 1.00		

TABLE XLIX

NABIDS, TIPTON, JULY 12, 1977 (D-Vac)

Variety	Mean
Sto. 213	17.00 a
HG-6-1-N	9.00 b
HG-BR-8-N	7.25 b
Sto. 731-N	6.00 b

$LSD_{.05} = 7.96$

TABLE L

HOODED BEETLES, TIPTON,
JULY 19, 1977 (D-Vac)

Variety	Mean
Sto. 213	1.50 a
Sto. 731-N	0.00 b
HG-BR-8-N	0.00 b
HG-6-1-N	0.00 b

$LSD_{.05} = 1.12$

TABLE LI

NABIDS, TIPTON, JULY 19, 1977 (D-Vac)

Variety	Mean
Sto. 213	9.75 a
HG-6-1-N	4.50 b
Sto. 731-N	3.50 b
HG-BR-8-N	2.50 b

$LSD_{.05} = 5.19$

TABLE LII

FLEAHOPPERS, TIPTON, 1977 (D-Vac)

	Variety	Seasonal Mean
	Sto. 213	46.63 a
	Sto. 731-N	25.56 b
	HG-6-1-N	20.19 b
	HG-BR-8-N	18.63 b
$LSD_{.01} = 6.95$		

TABLE LIII

BIG-EYED BUGS, TIPTON, 1977 (D-Vac)

	Variety	Seasonal Mean
	Sto. 213	0.50 a
	HG-BR-8-N	0.19 ab
	HG-6-1-N	0.13 ab
	Sto. 731-N	0.00 b
$LSD_{.05} = 0.43$		

TABLE LIV

HOODED BEETLES, TIPTON, 1977 (D-Vac)

	Variety	Seasonal Mean
	Sto. 213	1.31 a
	HG-BR-8-N	0.19 b
	Sto. 731-N	0.19 b
	HG-6-1-N	0.12 b
$LSD_{.01} = 0.80$		

TABLE LV

LADY BEETLES, TIPTON, 1977 (D-Vac)

Variety	Seasonal Mean
Sto. 213	2.31 a
HG-BR-8-N	0.44 b
Sto. 731-N	0.38 b
HG-6-1-N	0.31 b

$LSD_{.01} = 0.98$

TABLE LVI

NABIDS, TIPTON, 1977 (D-Vac)

Variety	Seasonal Mean
Sto. 213	15.81 a
HG-BR-8-N	8.81 b
HG-6-1-N	8.00 b
Sto. 731-N	7.63 b

$LSD_{.05} = 4.96$

TABLE LVII

BENEFICIAL ARTHROPODS, TIPTON, 1977 (D-Vac)

Variety	Seasonal Mean
Sto. 213	39.88 a
HG-6-1-N	23.06 b
Sto. 731-N	21.75 b
HG-BR-8-N	21.44 b

$LSD_{.05} = 12.33$

TABLE LVIII

COLLOPS BEETLES, TIPTON, JULY 13, 1977

	Variety	Mean
	Sto. 213	1.00 a
	HG-6-1-N	0.25 ab
	HG-BR-8-N	0.00 b
	Sto. 731-N	0.00 b
$LSD_{.05} = 0.97$		

TABLE LIX

LACEWING EGGS, TIPTON, JULY 13, 1977

	Variety	Mean
	Sto. 213	1.75 a
	HG-BR-8-N	0.50 ab
	HG-6-1-N	0.25 b
	Sto. 731-N	0.25 b
$LSD_{.05} = 1.30$		

TABLE LX

COLLOPS BEETLES, TIPTON, JULY 20, 1977

	Variety	Mean
	Sto. 213	0.75 a
	Sto. 731-N	0.50 ab
	HG-BR-8-N	0.00 b
	HG-6-1-N	0.00 b
$LSD_{.05} = 0.66$		

TABLE LXI

LACEWING EGGS, TIPTON, AUGUST 3, 1977

Variety	Mean
Sto. 213	16.75 a
HG-BR-8-N	16.50 ab
Sto. 731-N	9.75 ab
HG-6-1-N	8.50 b

$LSD_{.05} = 8.22$

TABLE LXII

LACEWING EGGS, TIPTON, AUGUST 10, 1977

Variety	Mean
Sto. 213	12.75 a
HG-BR-8-N	8.00 ab
HG-6-1-N	6.50 ab
Sto. 731-N	6.25 b

$LSD_{.05} = 6.14$

TABLE LXIII

COLLOPS BEETLES, TIPTON, AUGUST 24, 1977

Variety	Mean
HG-6-1-N	0.75 a
HG-BR-8-N	0.25 ab
Sto. 213	0.00 b
Sto. 731-N	0.00 b

$LSD_{.05} = 0.71$

TABLE LXIV

LACEWING EGGS, TIPTON, AUGUST 24, 1977

Variety	Mean
Sto. 731-N	43.50 a
Sto. 213	42.75 a
HG-BR-8-N	36.00 ab
HG-6-1-N	24.75 b

$LSD_{.05} = 16.22$

TABLE LXV

LADY BEETLES, TIPTON, JUNE 29, 1977

Variety	Mean
Sto. 731-N	1.75 a
HG-BR-8-N	1.25 a
Sto. 213	1.00 ab
HG-6-1-N	0.25 b

$LSD_{.05} = 0.83$

TABLE LXVI

NABIDS, TIPTON, JUNE 29, 1977

Variety	Mean
Sto. 731-N	4.00 a
Sto. 213	3.50 ab
HG-6-1-N	1.75 bc
HG-BR-8-N	1.50 c

$LSD_{.05} = 1.92$

TABLE LXVII

LADY BEETLES, TIPTON, JULY 6, 1977

Variety	Mean
Sto. 213	1.75 a
Sto. 731-N	0.25 b
HG-BR-8-N	0.25 b
HG-6-1-N	0.25 b

$LSD_{.05} = 1.12$

TABLE LXVIII

SPIDERS, TIPTON, JULY 13, 1977

Variety	Mean
Sto. 213	14.00 a
Sto. 731-N	11.00 ab
HG-BR-8-N	9.50 b
HG-6-1-N	8.00 b

$LSD_{.05} = 4.09$

TABLE LXIX

SPIDERS, TIPTON, JULY 20, 1977

Variety	Mean
Sto. 213	15.50 a
HG-BR-8-N	11.50 ab
HG-6-1-N	9.25 ab
Sto. 731-N	8.50 b

$LSD_{.05} = 6.43$

TABLE LXX

NABIDS, TIPTON, AUGUST 10, 1977

	Variety	Mean
	Sto. 731-N	1.50 a
	Sto. 213	1.00 ab
	HG-BR-8-N	1.00 ab
	HG-6-1-N	0.00 b
$LSD_{.05} = 1.32$		

TABLE LXXI

BOLL WEEVIL/<u>HELIOTHIS</u>-DAMAGED FRUIT,
TIPTON, AUGUST 10, 1977

	Variety	Mean
	Sto. 213	15.00 a
	Sto. 731-N	11.50 ab
	HG-BR-8-N	8.75 b
	HG-6-1-N	7.50 b
$LSD_{.05} = 5.62$		

TABLE LXXII

FLEAHOPPERS, TIPTON, 1977

	Variety	Seasonal Mean
	Sto. 213	20.28 a
	Sto. 731-N	11.94 b
	HG-BR-8-N	9.14 b
	HG-6-1-N	8.58 b
$LSD_{.01} = 3.82$		

TABLE LXXIII

BIG-EYED BUGS, TIPTON, 1977

Variety	Seasonal Mean
Sto. 213	0.11 a
Sto. 731-N	0.08 ab
HG-BR-8-N	0.03 bc
HG-6-1-N	0.00 c

$LSD_{.05} = 0.06$

TABLE LXXIV

LACEWING EGGS, TIPTON, 1977

Variety	Seasonal Mean
Sto. 213	10.22 a
HG-BR-8-N	9.56 a
Sto. 731-N	8.50 a
HG-6-1-N	6.19 b

$LSD_{.05} = 2.23$

TABLE LXXV

LACEWING ADULTS, TIPTON, 1977

Variety	Seasonal Mean
Sto. 213	0.83 a
HG-BR-8-N	0.53 ab
Sto. 731-N	0.50 ab
HG-6-1-N	0.25 b

$LSD_{.05} = 0.34$

TABLE LXXVI

HOODED BEETLES, TIPTON, 1977

Variety	Seasonal Mean
Sto. 213	1.08 a
HG-BR-8-N	0.36 b
HG-6-1-N	0.33 b
Sto. 731-N	0.22 b
$LSD_{.05} = 0.43$	

TABLE LXXVII

SPIDERS, TIPTON, 1977

Variety	Seasonal Mean
Sto. 213	8.53 a
HG-BR-8-N	7.00 b
Sto. 731-N	6.44 b
HG-6-1-N	5.83 b
$LSD_{.05} = 1.49$	

TABLE LXXVIII

BENEFICIAL ARTHROPODS, TIPTON, 1977

Variety	Seasonal Mean
Sto. 213	24.92 a
HG-BR-8-N	20.58 b
Sto. 731-N	19.06 b
HG-6-1-N	14.97 c
$LSD_{.05} = 3.66$	

TABLE LXXIX

HELIOTHIS EGGS, TIPTON, 1977

	Variety	Seasonal Mean
	Sto. 731-N	3.31 a
	Sto. 213	3.00 a
	HG-BR-8-N	2.67 ab
	HG-6-1-N	1.92 b
$LSD_{.05} = 0.90$		

TABLE LXXX

HELIOTHIS LARVAE, TIPTON, 1977

	Variety	Seasonal Mean
	Sto. 731-N	5.11 a
	Sto. 213	3.64 ab
	HG-BR-8-N	2.50 b
	HG-6-1-N	2.19 b
$LSD_{.01} = 2.07$		

TABLE LXXXI

BOLL WEEVIL/*HELIOTHIS*-DAMAGED FRUIT,
TIPTON, 1977

	Variety	Seasonal Mean
	Sto. 731-N	9.61 a
	Sto. 213	8.21 ab
	HG-6-1-N	6.71 b
	HG-BR-8-N	6.04 b
$LSD_{.05} = 2.22$		

TABLE LXXXII

YIELD, TIPTON, 1976

Variety	Seasonal Mean*
Sto. 213	1132.03 a
Sto. 731-N	997.67 ab
HG-6-1-N	982.25 ab
La. 17801	859.95 b
HG-BR-8-N	752.45 b

$LSD_{.05} = 238.41$

*Pounds of lint/acre

TABLE LXXXIII

YIELD, TIPTON, FIRST HARVEST, SEPTEMBER 23, 1976*

Variety	Mean
HG-6-1-N	50.23 a
HG-BR-8-N	32.95 b
Sto. 213	26.93 b
La. 17801	25.98 b
Sto. 731-N	14.33 c

$LSD_{.05} = 9.57$

*Given as percentage of total yield

TABLE LXXXIV

YIELD, TIPTON, SECOND HARVEST,
OCTOBER 14, 1976*

Variety	Mean
Sto. 213	49.23 a
Sto. 731-N	42.10 ab
La. 17801	40.25 ab
HG-BR-8-N	37.40 bc
HG-6-1-N	30.33 c

$LSD_{.05} = 9.57$

*Given as percentage of total yield

TABLE LXXXV

YIELD, TIPTON, THIRD HARVEST,
NOVEMBER 11, 1976*

Variety	Mean
Sto. 731-N	43.60 a
La. 17801	33.75 ab
HG-BR-8-N	29.63 b
Sto. 213	23.88 bc
HG-6-1-N	19.43 c

$LSD_{.05} = 9.57$

*Given as percentage of total yield

TABLE LXXXVI

COTTON QUALITY, CHICKASHA, 1976

	Fibrograph			Stelometer	
Variety	2.5% Span Length	Uniformity Index	Avg. Micronaire	0" Gauge	1/8" Gauge
HG-6-1-N	1.104	40.2	3.9	44.0	20.0
HG-BR-8-N	1.079	42.9	4.4	44.6	21.6
Sto. 731-N	1.164	43.8	4.3	41.3	21.2
Sto. 213	1.136	44.3	3.9	38.5	20.3
La. 17801	1.141	43.0	4.4	45.9	21.6

TABLE LXXXVII

COTTON QUALITY, TIPTON, SEPTEMBER 24, 1976

	Fibrograph			Stelometer	
Variety	2.5% Span Length	Uniformity Index	Avg. Micronaire	0" Gauge	1/8" Gauge
HG-6-1-N	1.032	42.4	4.3	50.0	18.0
HG-BR-8-N	1.043	43.0	4.6	53.9	21.0
Sto. 731-N	1.051	44.4	5.1	51.1	19.2
Sto. 213	1.050	45.0	5.2	47.2	19.4
La. 17801	1.097	42.9	4.4	50.7	20.9

TABLE LXXXVIII

COTTON QUALITY, TIPTON, NOVEMBER 14, 1976

	Fibrograph			Stelometer	
Variety	2.5% Span Length	Uniformity Index	Avg. Micronaire	0" Gauge	1/8" Gauge
HG-6-1-N	1.084	43.2	5.0	5.06	21.3
HG-BR-8-N	1.084	42.6	4.4	42.7	23.4
Sto. 731-N	1.068	46.4	5.0	44.4	21.0
Sto. 213	1.088	46.0	5.3	41.7	20.0
La. 17801	1.104	44.9	4.8	47.8	21.0

TABLE LXXIX

COTTON QUALITY, TIPTON, SEPTEMBER 19, 1977

		Fibrograph				Stelometer	
Variety	Replication	2.5% Span Length	50% Span Length	Uniformity Index	Average Micronaire	0" Gauge	1/8" Gauge
Sto. 213	1	1.094	.539	49.3	5.1	39.0	20.7
	2	1.140	.548	48.1	4.8	39.7	20.5
	3	1.023	.499	48.8	5.7	39.3	21.4
	4	1.083	.504	46.5	5.0	42.6	23.9
Sto. 731-N	1	1.124	.523	46.5	4.5	42.6	22.2
	2	1.135	.539	47.5	4.9	46.2	20.5
	3	1.042	.466	44.7	4.4	45.7	21.6
	4	1.057	.487	46.1	4.7	45.4	19.7
HG-BR-8-N	1	1.097	.504	45.9	4.1	44.5	19.9
	2	1.083	.487	45.0	4.7	43.6	20.5
	3	1.097	.505	46.8	4.7	43.0	20.8
	4	1.023	.467	45.7	4.0	46.6	20.5
HG-6-1-N	1	1.089	.504	46.3	4.7	44.9	20.2
	2	1.121	.514	45.9	4.7	46.5	20.5
	3	1.067	.489	45.8	5.0	46.2	20.7
	4	1.050	.494	47.0	4.5	48.2	23.0

TABLE XC

COTTON QUALITY, TIPTON, DECEMBER 2, 1977

		Fibrograph				Stelometer	
Variety	Replication	2.5% Span Length	50% Span Length	Uniformity Index	Average Micronaire	0" Gauge	1/8" Gauge
Sto. 213	1	1.092	.493	45.1	4.2	38.7	18.1
	2	1.093	.481	44.0	3.6	40.0	18.1
	3	1.070	.480	44.9	4.3	40.5	18.4
	4	1.063	.481	45.2	3.8	39.7	19.9
Sto. 731-N	1	1.094	.463	42.3	3.8	41.4	17.7
	2	1.090	.492	45.1	4.1	41.7	17.9
	3	1.064	.448	42.1	4.2	41.3	18.5
	4	1.094	.488	44.6	4.3	37.1	17.3
HG-BR-8-N	1	1.043	.449	43.0	3.5	41.7	19.6
	2	1.039	.455	43.8	3.8	42.5	18.4
	3	1.020	.415	40.7	4.0	41.6	18.9
	4	0.966	.409	42.3	3.2	39.0	17.4
HG-6-1-N	1	1.034	.417	40.3	3.7	44.3	17.7
	2	1.073	.441	41.1	3.6	43.8	19.6
	3	1.068	.446	41.8	3.4	43.2	20.3
	4	1.047	.440	42.0	3.1	44.4	21.8

TABLE XCI

COTTON QUALITY, MANGUM, 1977

Variety	Replication	Fibrograph 2.5% Span Length	Fibrograph 50% Span Length	Fibrograph Uniformity Index	Average Micronaire	Stelometer 0" Gauge	Stelometer 1/8" Gauge
Sto. 213	1	1.088	.479	44.0	3.5	43.9	20.5
	2	1.105	.485	43.9	4.1	41.4	19.6
	3	1.183	.527	44.5	3.9	44.0	20.5
	4	1.051	.469	44.6	4.1	45.7	19.1
Sto. 731-N	1	1.106	.466	42.1	3.8	44.9	21.7
	2	1.140	.512	44.9	4.5	41.4	20.5
	3	1.137	.496	43.6	3.7	46.2	21.7
	4	1.084	.466	43.0	4.1	45.4	18.4
HG-BR-8-N	1	1.125	.521	46.3	3.5	43.6	21.6
	2	1.107	.490	44.3	4.6	48.6	20.8
	3	1.130	.506	44.8	3.9	39.6	20.5
	4	1.055	.459	43.5	3.8	44.9	18.8
HG-6-1-N	1	1.077	.479	44.5	4.1	45.6	24.2
	2	1.160	.529	45.6	4.6	39.7	21.1
	3	1.032	.466	45.2	3.9	46.0	20.0
	4	1.098	.483	44.0	4.1	42.3	20.0

TABLE XCII

YIELD, FIRST HARVEST, TIPTON,
SEPTEMBER 19, 1977*

Variety	Mean
Sto. 731-N	77.53 a
HG-6-1-N	71.50 ab
Sto. 213	66.05 b
HG-BR-8-N	63.80 b

$LSD_{.05} = 9.71$

*Given as percentage of total yield

TABLE XCIII

YIELD, CHICKASHA, 1977

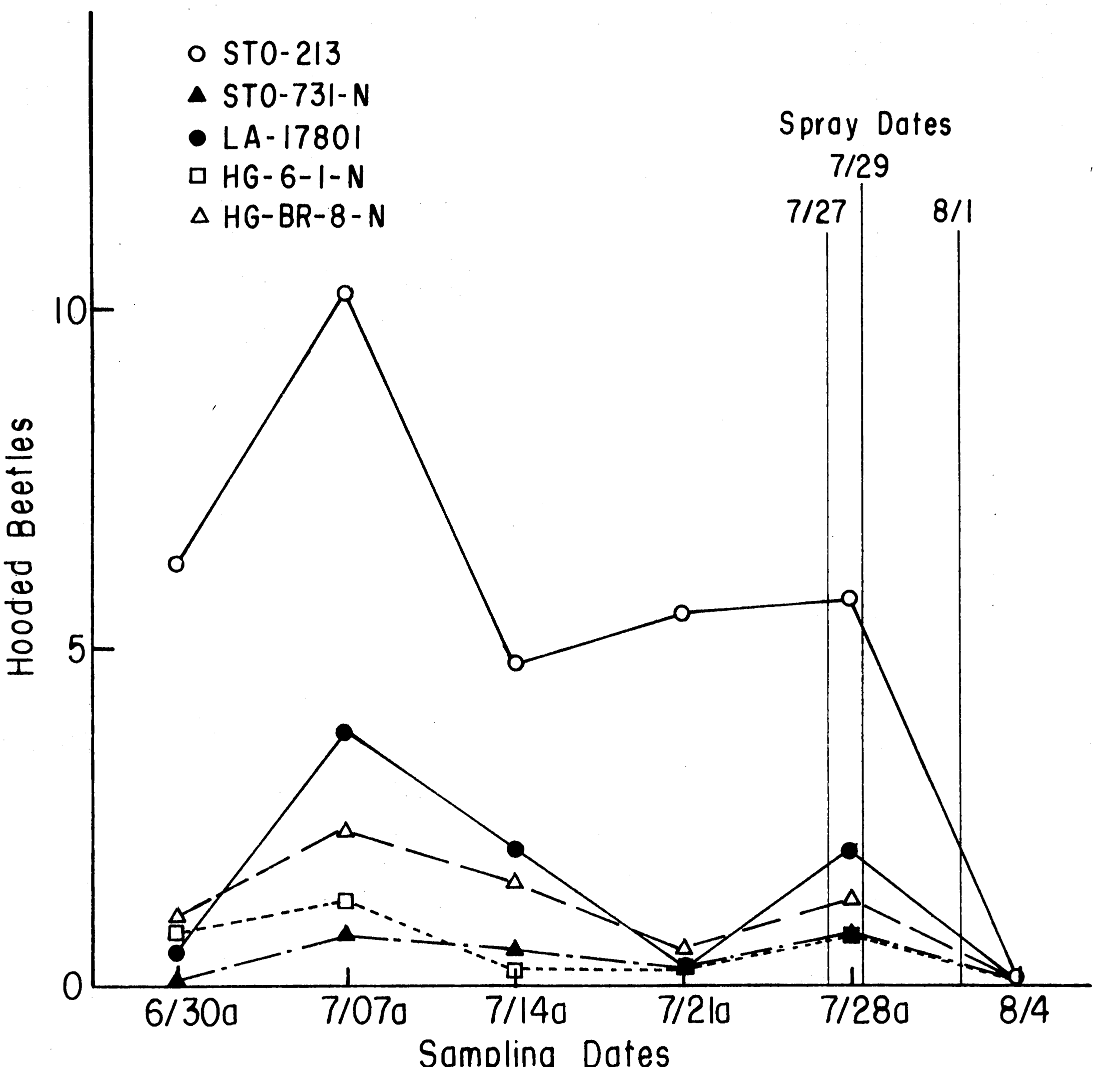
Variety	Mean*
HG-6-1-N	747.53 a
Sto. 213	650.98 ab
Sto. 731-N	638.30 ab
HG-BR-8-N	576.13 b

$LSD_{.05} = 128.41$

*Pounds of lint per acre

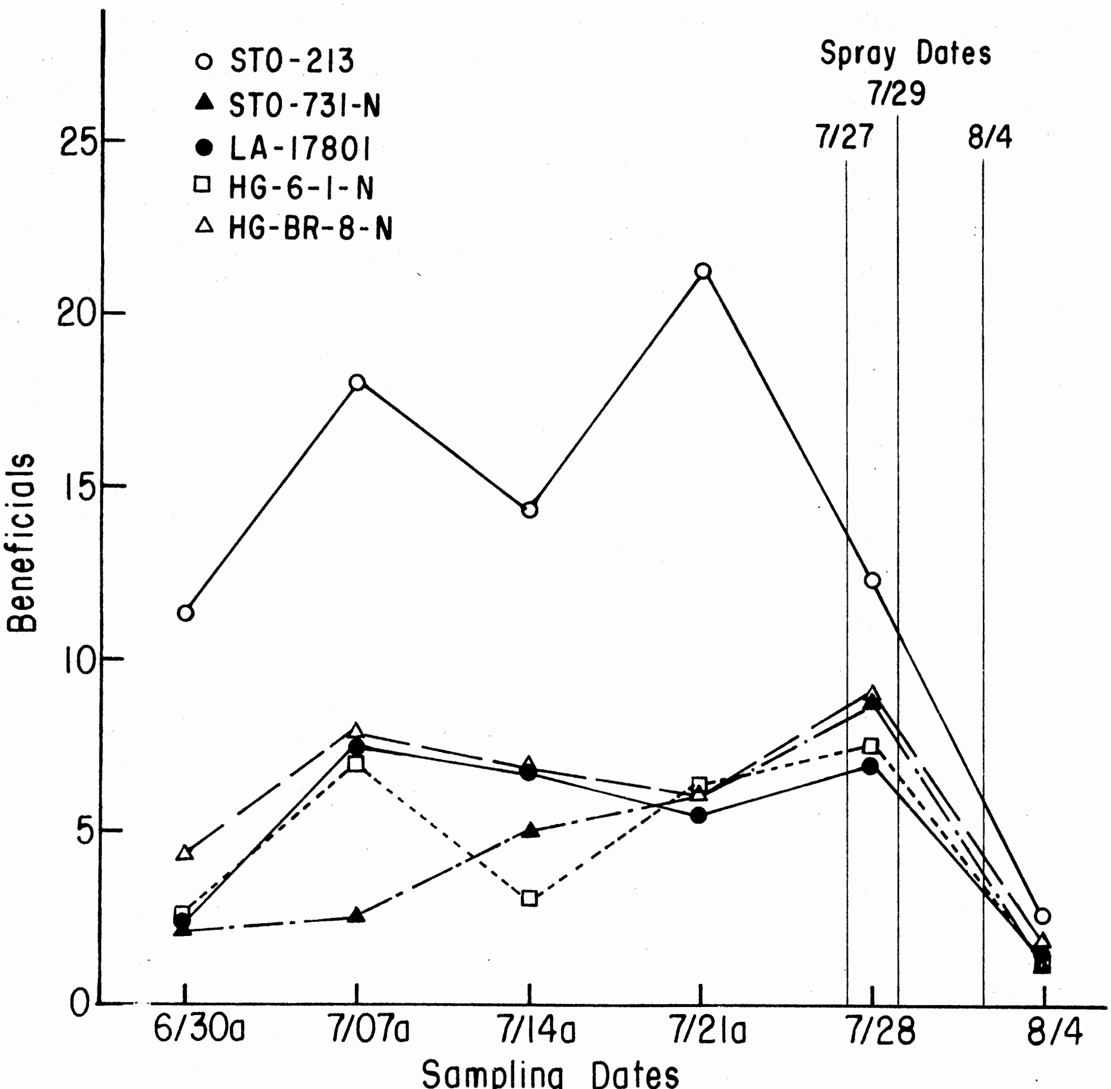
APPENDIX B

FIGURES



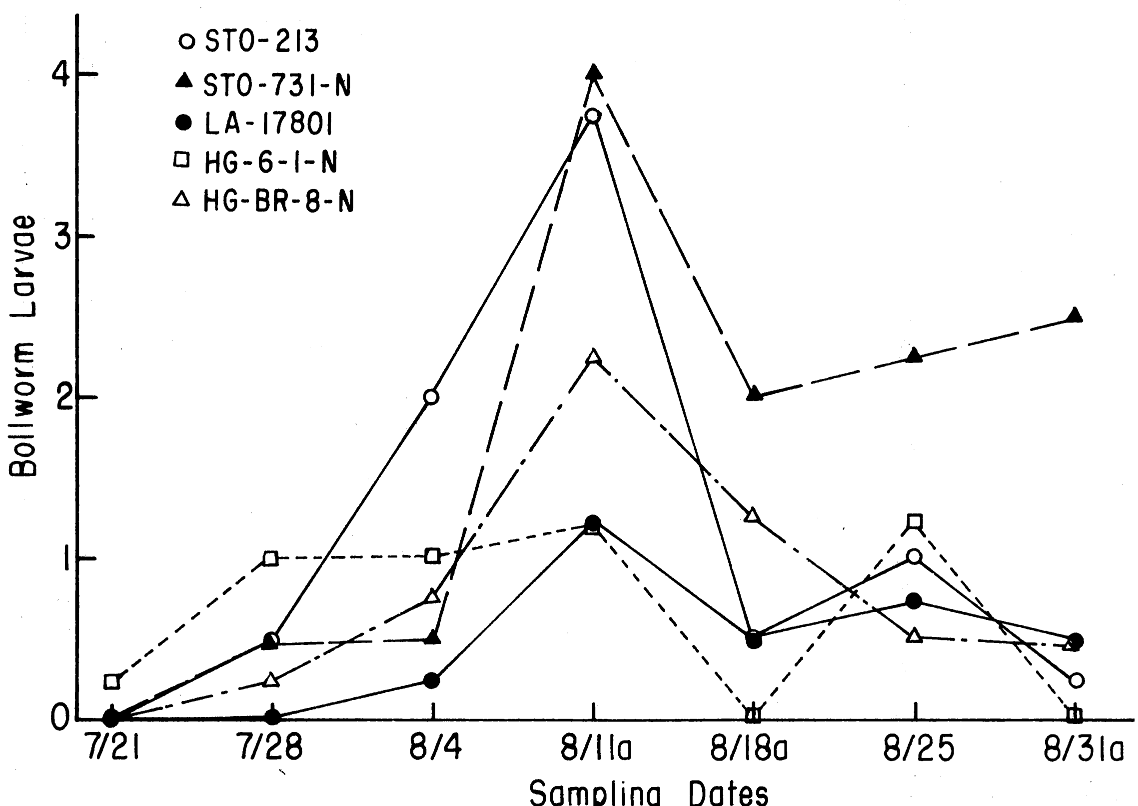
a--Indicates dates when hooded beetle numbers were significantly different at the 5% level

Figure 1. Mean Number of Hooded Beetles by Variety and by Date, Tipton, 1976



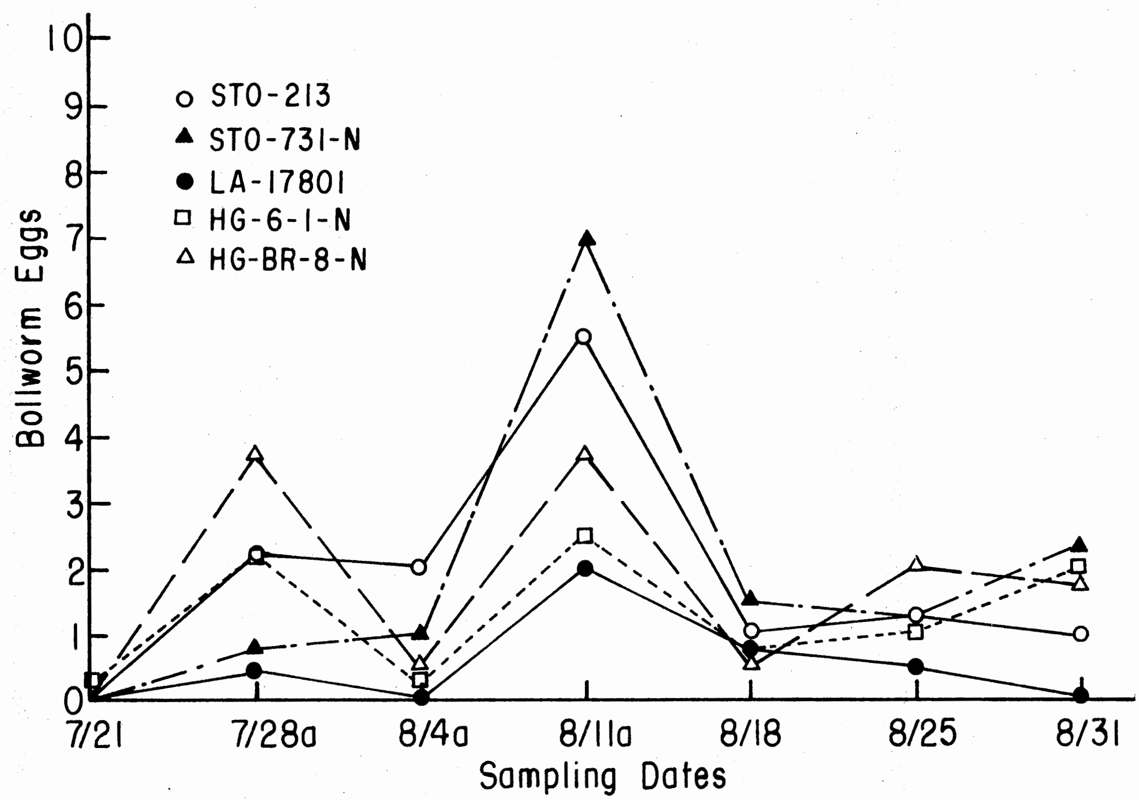
a--Indicates dates when total beneficial insect numbers were significantly different at the 5% level

Figure 2. Mean Number of Beneficial Arthropods by Variety and by Date, Tipton, 1976



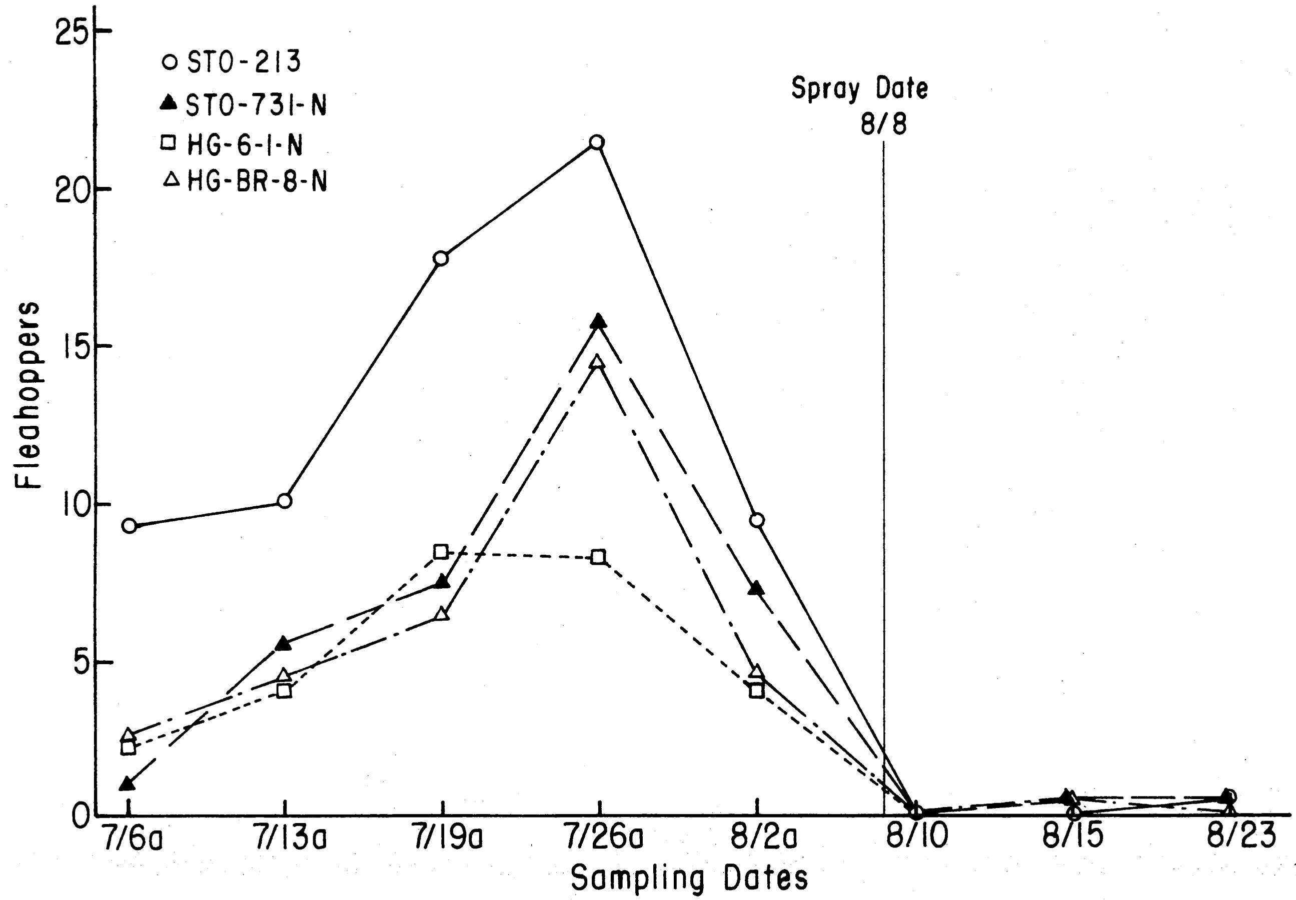
a--Indicates dates when bollworm larvae numbers were significantly different at the 5% level

Figure 3. Mean Number of Bollworm Larvae by Variety and by Date, Tipton, 1976



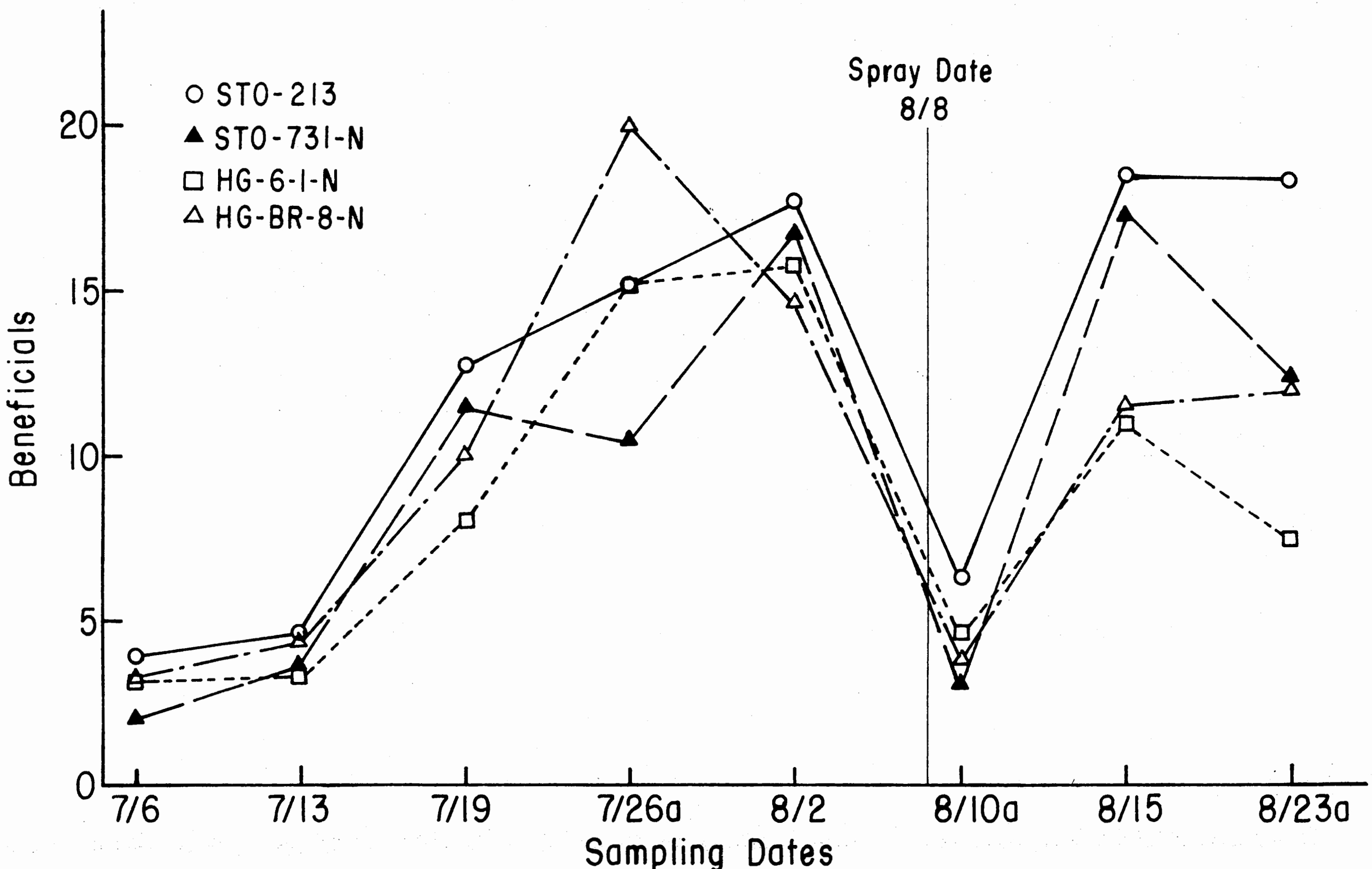
a--Indicates dates when bollworm egg numbers were significantly different at the 5% level

Figure 4. Mean Number of Bollworm Eggs by Variety and by Date, Tipton, 1976



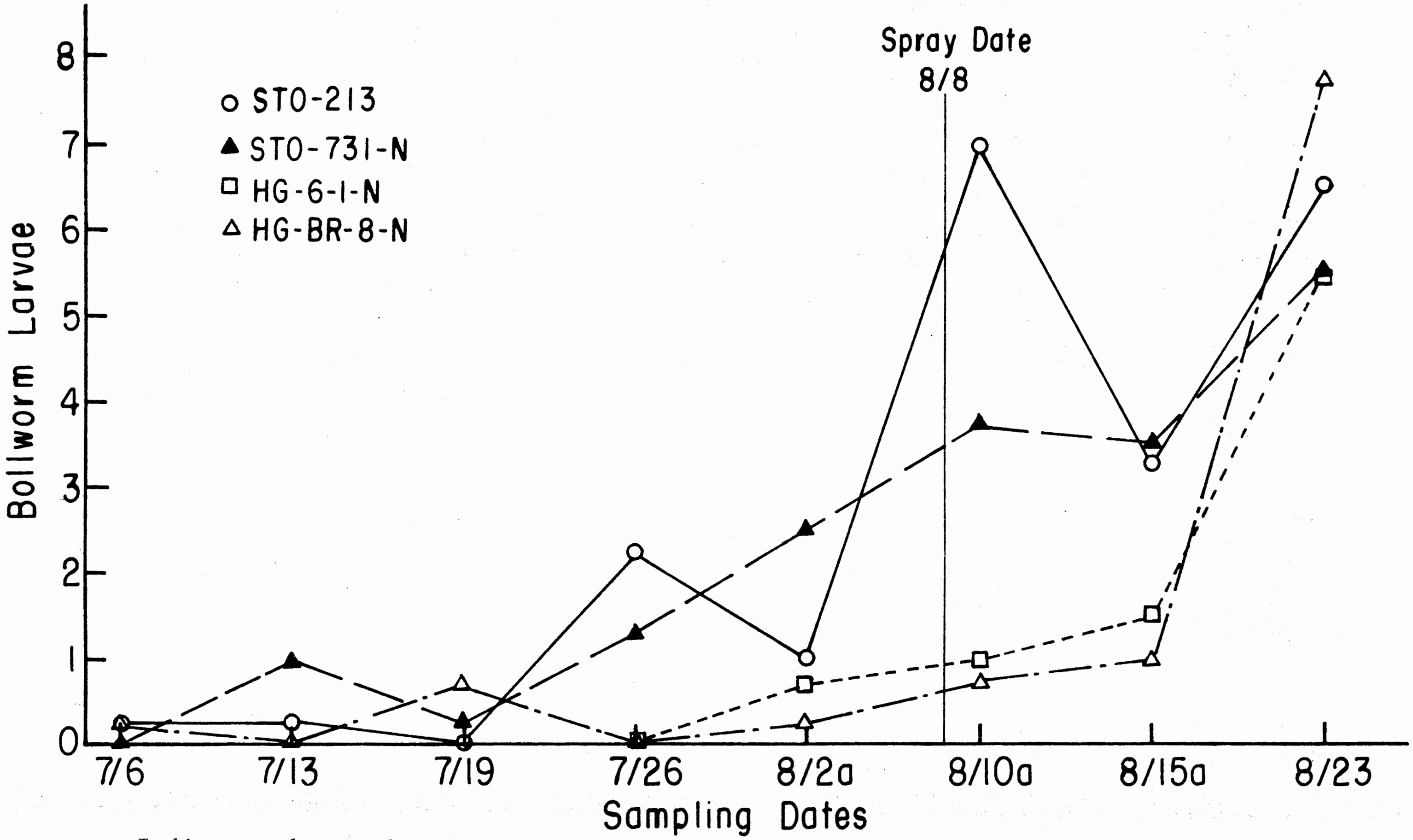
a--Indicates dates when fleahopper populations were significantly different at the 5% level

Figure 5. Mean Number of Fleahoppers by Variety and by Date, Chickasha, 1977



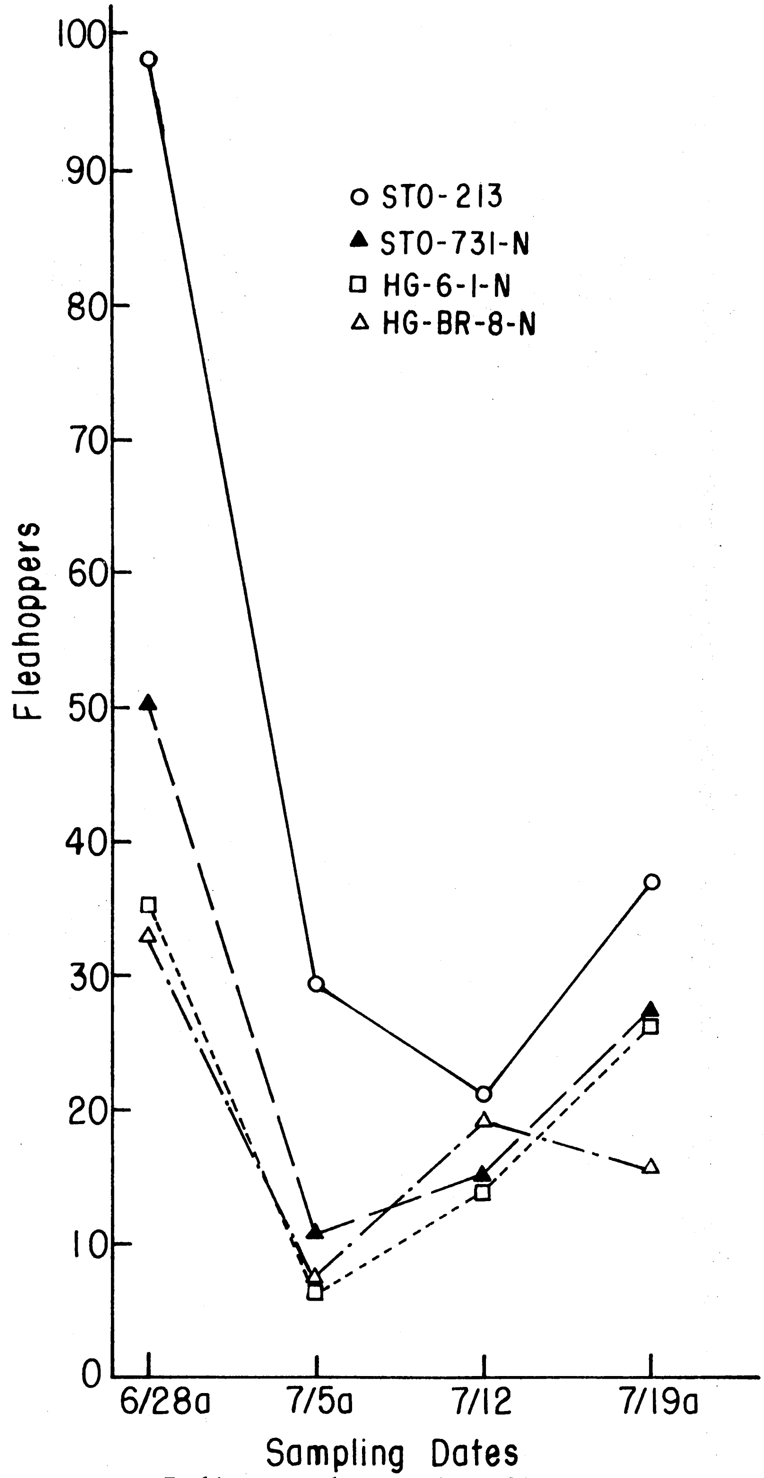
a--Indicates dates when total beneficial arthropod populations were significantly different at the 5% level

Figure 6. Mean Number of Beneficial Arthropods by Variety and by Date, Chickasha, 1977



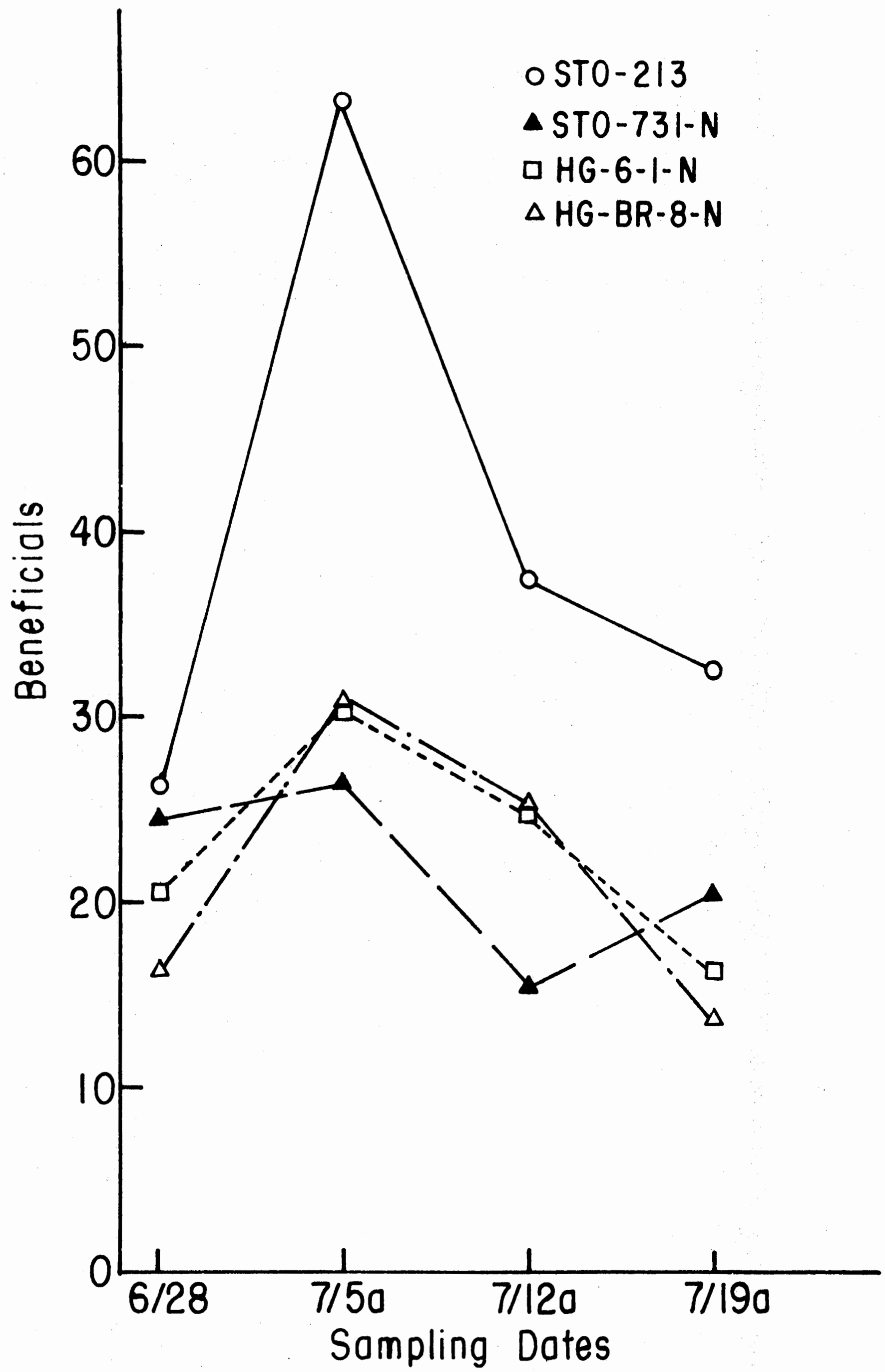
a--Indicates dates when bollworm larvae numbers were significantly different at the 5% level

Figure 7. Mean Number of Bollworm Larvae by Variety and by Date, Chickasha, 1977



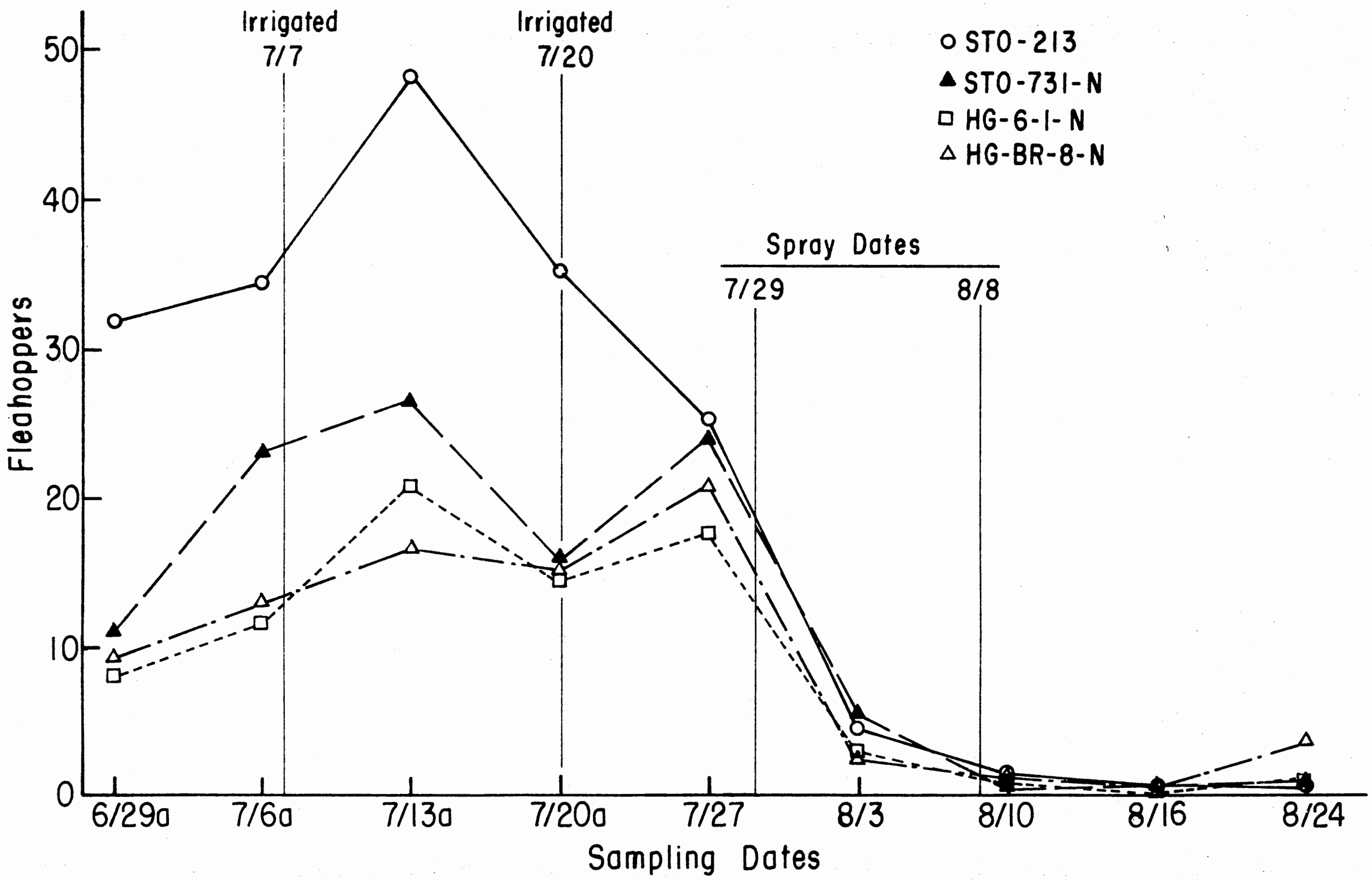
a--Indicates dates when fleahopper populations were significantly different at the 5% level

Figure 8. Mean Number of Fleahoppers by Variety and by Date, Tipton, 1977 (D-Vac Samples)



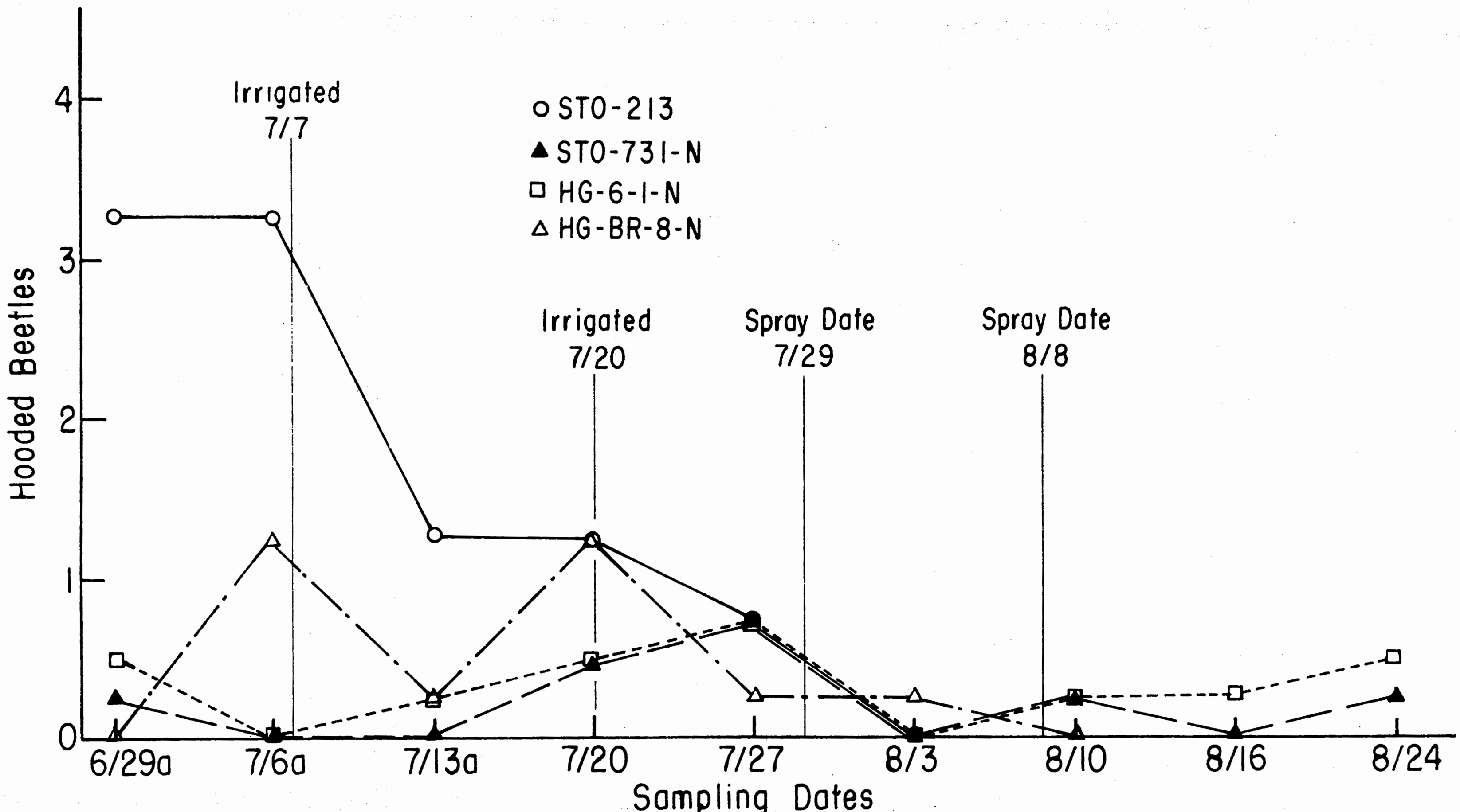
a--Indicates dates when beneficial arthropod populations were significantly different at the 5% level

Figure 9. Mean Number of Beneficial Arthropods by Variety and by Date, Tipton, 1977 (D-Vac Samples)



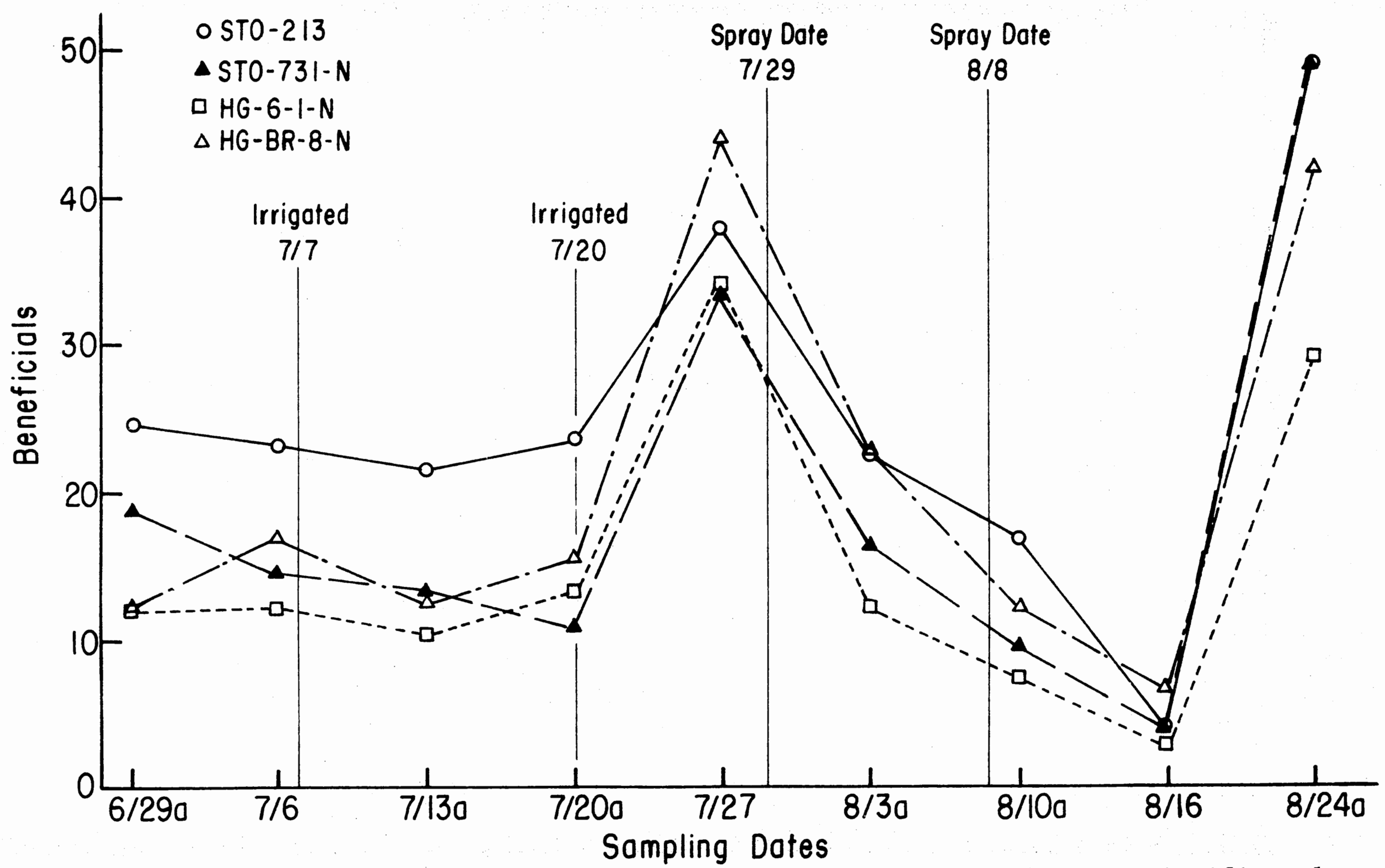
a--Indicates dates when fleahopper populations were significantly different at the 5% level

Figure 10. Mean Number of Fleahoppers by Variety and by Date, Tipton, 1977



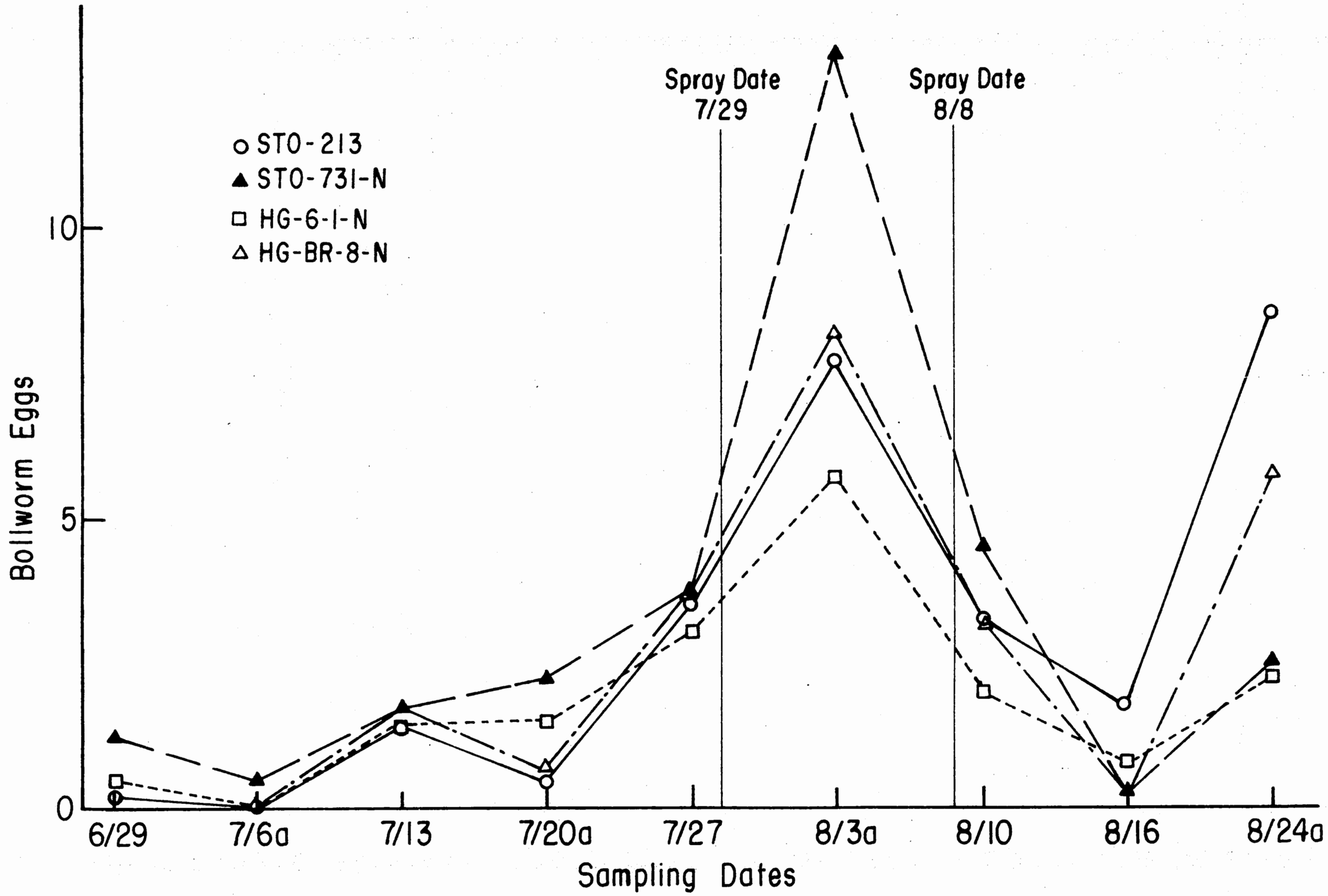
a--Indicates dates when hooded beetle populations were significantly different at the 5% level

Figure 11. Mean Number of Hooded Beetles by Variety and by Date, Tipton, 1977



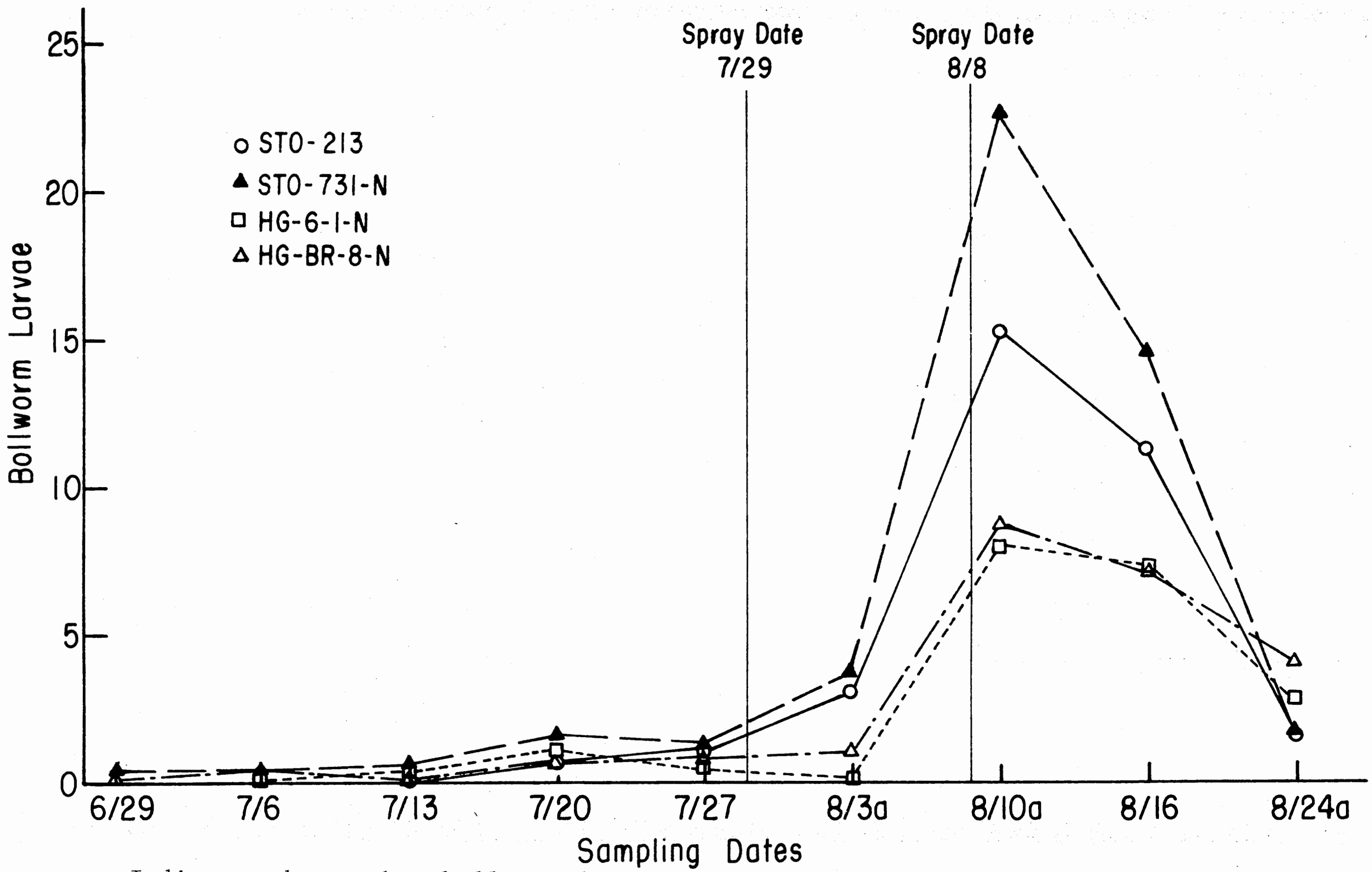
a--Indicates dates when beneficial arthropod population levels were significantly different at the 5% level

Figure 12. Mean Number of Beneficial Arthropods by Variety and by Date, Tipton, 1977



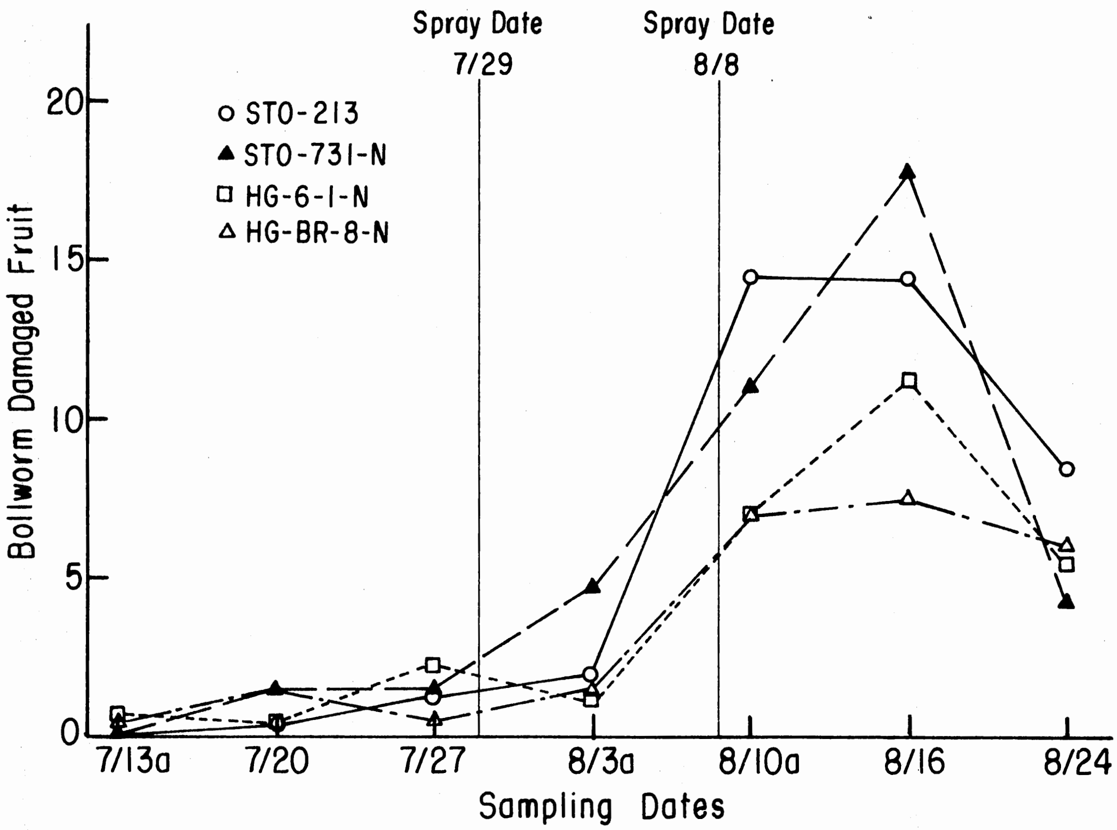
a--Indicates dates when bollworm egg numbers were significantly different at the 5% level

Figure 13. Mean Number of Bollworm Eggs by Variety and by Date, Tipton, 1977



a--Indicates dates when bollworm larvae numbers were significantly different at the 5% level

Figure 14. Mean Number of Bollworm Larvae by Variety and by Date, Tipton, 1977



a--Indicates dates when varieties differed significantly at the 5% level in numbers of bollworm-damaged fruit

Figure 15. Mean Number of Bollworm-Damaged Fruit by Variety and by Date, Tipton, 1977

VITA 2

Kevin Scott Mussett

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Master of Science

Thesis: FIELD EVALUATION OF INSECT-RESISTANT VARIETIES ON POPULATIONS OF THE COTTON BOLLWORM AND TOBACCO BUDWORM, BENEFICIAL INSECTS AND SPIDERS, FRUIT DAMAGE, AND YIELD OF COTTON

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